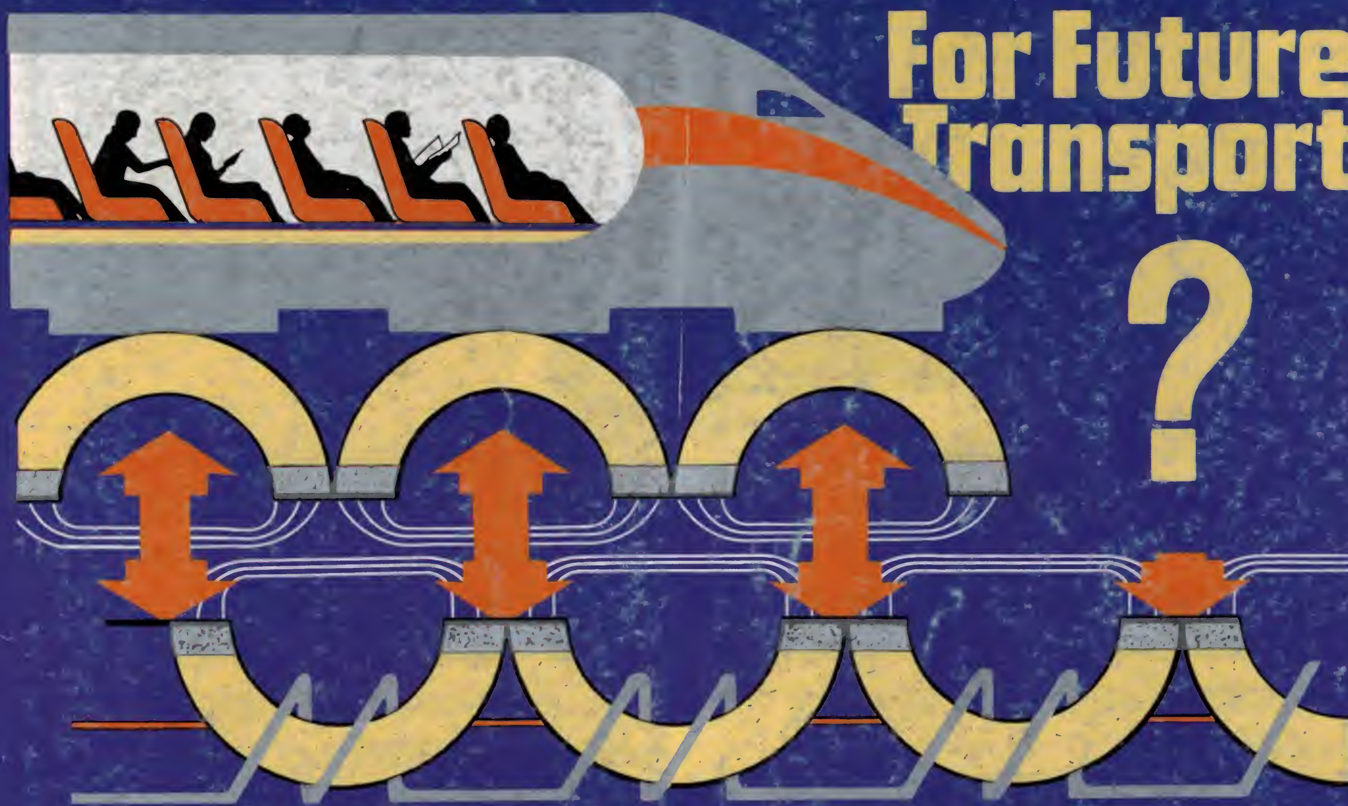
NOV. 1981 $1.95* NZ $2.50

eti ELECTRONICS TODAY INTERNATIONAL

MAGNETIC LEVITATION

For Future Transport ?



Completing the 660 LEARNERS' MICROCOMPUTER

Handheld Printer

'Low Ohms' Meter to build

CARVER Magnetic Field Amplifier Reviewed

The easiest way to get a better sound system.

Put in a Maxell Cassette.

You'll soon discover why most critics recognise Maxell as the finest recording tape money can buy.

For example, every batch of the magnetic oxide particles we use to coat our tape is run through an electron microscope.

If it isn't perfect, we don't use it.

On some brands of tape the magnetic oxide particles fall off as the tape gets older, taking some of your music with them.

So we developed a special binding process to make sure they stay on, even after years of use.

Why do we go to so much trouble?

It stands to reason that if you use better tape, your sound system will sound better.

maxell®

For further information on Maxell Tapes write to Maxell Advisory Service, Private Bag P.O. Kingsgrove 2208 or Phone: (02) 750 3777.

MX0035/FMMH

Registered by Australia Post —
Publication No. NBP0407
ISSN No. 0013-5216

ELECTRONICS TODAY INTERNATIONAL

BLANK TAPES & CARTE BLANCHE

DOES YOUR PURCHASE of blank audio or video tape provide you with a carte blanche to infringe copyright? Apparently the Australian Copyright Council thinks it does. Proposals suggested in a lengthy report from the Council, recently presented to the Federal Attorney General's Department, would require purchasers of blank audio or video tape to pay a levy, the purpose of which would be to offset alleged losses of earnings of copyright holders brought about by unauthorised copying of recorded works.

The Federal Attorney General announced recently that audio-visual provisions of the Copyright Act will be reviewed. No doubt the question of the rights of copyright owners and consumers will be examined along with the idea of imposing a levy on blank recording media.

This question has been examined at length overseas. The British Government recently decided not to impose a levy on blank tapes as it would be an unfair impost on those who purchased blank tape for exchanging 'talking letters' or recording the baby's first words or similar purposes where recording did not involve copying of previously recorded material. (See our lead story in Sight & Sound this month, page 143).

It is perhaps significant that no country with British law has legislated to impose a levy on products where it may be possible to breach copyright. Even if such a levy were imposed it can be circumvented by selling tapes with prerecorded trivia on it at low level — even white or pink noise would probably suffice.

One can sympathise with performers, recording companies and other copyright holders who fear or believe that a substantial portion of their income is lost or eroded by people making unauthorised copies of their recorded works. But any claims are largely unsupported by statistics or reasonable estimates — principally because such figures are well-nigh impossible to obtain.

The situation has produced a 'Mexican standoff'. But is a levy the just way to go about righting a prima facie wrong? The whole issue is very complex and a ministerial 'review' of legislative provisions will not see justice done. A public inquiry would.

Roger Harrison

Roger Harrison
Editor

QUICK INDEX

FEATURES

PROJECTS & TECHNICAL

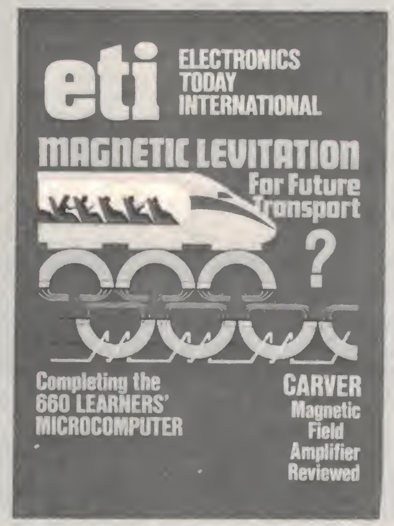
COMPUTING TODAY

SIGHT & SOUND

GENERAL

advertisers

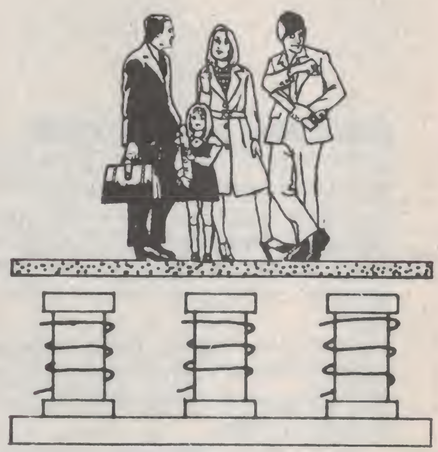
ELECTRONICS TODAY INTERNATIONAL



Magnetic levitation for transport applications has had its ups and downs ... but may come to fruition yet, according to this month's feature article. Cover design and layout by Ali White and Githa Pilbrow from an idea by Roger Harrison.

* Recommended retail price only.

features



computing

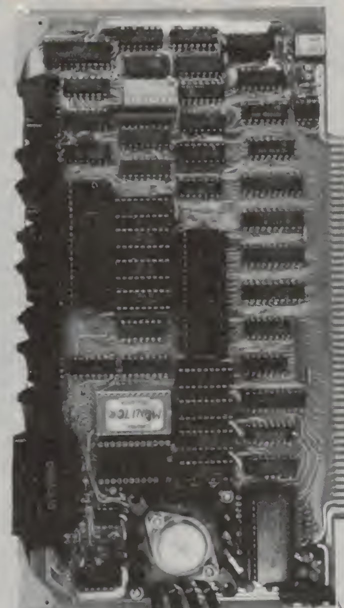
news

projects

sight & sound

general

next month



2650 S100 COMPUTER CARD

As promised! The latest in our line of S100 computer projects features the 2650 microprocessor, 4K of on-board RAM and 4K of on-board EPROM, an RS-232C serial port and a latched 8-bit parallel-in 'keyboard' port, DMA capability and a programmable interrupt controller. It is compatible with past ETI S100 projects (ETI-640 VDU, ETI-681 PCG, etc) and a variety of monitor ROMs are available — but wait! — a new one has become available and a full description will be included in a separate article. For the computer buff — not to be missed!

WIN A COMPUTER

You can win a System 80 from Dick Smith simply by entering our new contest — an opportunity not to be passed up.

SLOT CAR CONTROLLERS

"Let's not beat about the bush. Slot cars are fun!", says Jonathan Scott. And he should know. He has just spent the last two months exploring the world of slot cars and how to control them electronically. From an initial outlay of $15 for your *basic* slot car set, Jonathan thought there *must* be a better method of control other than the crude ones he got. There is. More than one way, in fact. These two projects are they. You can have controlled acceleration, with overshoot, dynamic braking and 'electronic' fuel tanks, etc, etc. Be a kid again this Christmas.

KEYBOARD BEEPER FOR THE SORCERER

An ingenious and useful addition for this popular microcomputer. An ultra-simple circuit that alerts you that your machine is ready for the next entry.

INSIDE QUAD'S NEW ELECTROSTATIC SPEAKERS

It's many years since Quad introduced their legendary electrostatic loudpseakers. There has been considerable talk about thier new model since it was launched earlier this year. Brian Dance takes you inside for a fascinating view.

Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

NEW ZEALANDERS ARE SAVING UP TO 75%

thanks to Dick Smith opening his first store in Auckland.

Dick is now able to give New Zealanders the same sort of savings available to his Australian customers.

and Peter makes Dick Smith Electronics feel at home . . .

Thousands of happy customers have called in to our Auckland store to thank us for opening in New Zealand.

Thirteen-year-old Peter Murray was typical of the letters we received: only he took the trouble to write to Dick directly.

To all of the Peter Murrays in New Zealand, Dick says 'Thank You. I'll continue to bring you the best in electronics at the lowest prices possible'.

10 Alton tce
Pakuranga
Auckland
New Zealand
10/7/81

Dear Mr Dick Smith,

I am 13 yrs old and an electronics enthusiast. I would like to welcome you and your stores from the bottom of my heart to New Zealand.

I have just finished reading the letter appearing in your New Zealand catalogue, and would like to say that even with 25% of your stock in this country, you are saving the electronic enthusiast from the fatal disease 'Money loss'. Speaking on behalf of electronic enthusiasts we can't thank you enough.

Well, there is more I can say but I'll leave it to other grateful customers, so Thank you again and good luck in the 'land of the long White Cloud'!!

Yours Thankfully
Peter Murray

Even if you don't live in Auckland, you can still take advantage of Dick Smith's low prices.

You can purchase from our wide range of items through our Mail Order Centre. Take advantage of our 14 years experience in mail ordering in Australia.

You'll get the same great service our Australian customers have come to appreciate.

See our address panel for Showroom and Mail Order Centre location.

DICK SMITH Electronics

MAIL ORDER CENTRE AND SHOWROOM:
96-98 Carlton Gore Road, Newmarket, Auckland 1
Phone: Auckland 50 4408 — 50 4409

STORE HOURS: Monday to Friday: 8.30am to 5pm

bankcard
welcome here

Call into our store and collect your copy of our 1st Edition Catalogue.

DSE/A060/LM

Australia — importing the future?

Many people in Australia, including the Governor-General and leading figures in the computer industry, have expressed the fear that Australia will soon be importing its future from overseas if there is no change in Federal Government policy on preference for local technology.

Mr. Paul Edwards, general manager and director of the Australian company Digital Electronics, which recently won an Industrial Design Council of Australia award for its efforts in designing a family of computers, claims that members of high technology industries are not arguing for protection merely to put money in their own pockets. The argument for protection is that as long as the quality is at least of the same standard as that of an overseas product, it is worth paying a premium for a local product because jobs are preserved and created.

"If the Australian Government wants to help build a local industry and keep skilled people in Australia, the simple way is to support industry by local purchase," said Mr. Edwards.

"Each year at this time I get inundated with enquiries from university and technical college graduates wanting to participate in the manufacture of computers. They can only be involved if there is a vibrant high technology industry.

"Recently a high-school principal asked me why it was difficult to find jobs for some technically oriented school leavers who didn't want to go to university. I answered with a question: how many Australian-made computers, laboratory instruments, etc, have you got at your school? His reply was: none!

"So where are our young people to get their training? What will happen to the industry to which they are looking for employment? The abolition of tedious production line jobs is, according to government rhetoric, supposed to be replaced by jobs in the new technology.

"I fail to see what help this is to our young people if all the new technology jobs are overseas. And governments can hardly help to create jobs in private enterprise in Australia by buying from overseas.

"Technology is not like footwear or cheap clothing from Asia ... without our own technological reservoir we are completely vulnerable to the economic machinations of our competitors. We lose our most skilled and far-sighted citizens to overseas companies, and we export our resources for nothing more than a lease on the twentieth century."

The Governor-General, Sir Zelman Cowan, recently joined the argument by warning that Australia's dependence on imported technology could lead to vulnerability in time of war.

Mr. Edwards, however, sees the dangers of reliance on imported technology and the lack of encouragement for local production as more far-reaching than merely military.

"The nation may survive a threat of war, but in the meantime its industry — which supports the people — may wither through government neglect ... it (is) even more surprising that the Federal Government in a pre-Budget decision abolished its own purchasing policy of preference for locally manufactured goods — a decision which means that Australian industry is now likely to become even more dependent on competing nations for technology.

"While other countries and organisations like the EEC practise protection for their products, the Federal Government seems to have decided that Australia will make a unilateral and pointless act of self-sacrifice.

"Last year more than $500 million in computer equipment was imported into Australia. Much of this was bought by governments — a massive support of overseas industry that does nothing for the Australian economic environment."

A recently formed group — the Association of Australian High Technology Industries (AAT) — is concerned with precisely the same problem as that outlined by Mr. Edwards, and has as its aim the furthering and promotion of indigenous high technology industry.

The AAT's interim president, Mr. Will Fiala, said that stress would be placed on the 'home-grown' high technology industry's ability not only to generate considerable employment but also to remove both economic and military dangers to the Government and the community in terms of over-reliance on overseas products.

Mr. Fiala said the AAT would also lobby hard to attract venture capital to aid sound, planned growth in the industry. The AAT would mount an educational and marketing program and seek to change all Australian governments' attitudes towards local aid.

The AAT has said it will seek to work closely with the trade union movement in Australia, not only to overcome the fear of the introduction of high technology but also to gain support to reverse the trend to import this technology when it is readily available here.

According to Mr. Fiala, the group has already attracted considerable interest from Federal and state government departments, from consultants and from many other potential members. Membership is open to Australian high technology companies, and a brochure about the group and its aims, including an application form, is to be distributed widely throughout Australia.

A major conference/symposium is planned for November, in which the AAT will strongly put its case for the planned growth of the Australian high technology industry.

Mr. Fiala, who is managing director of the Melbourne-based company Alfatron, may be contacted on (03)758-9551. A spokesman for AAT, Mr. Simon Feely, is available on (03)62-1176, and the Association may be contacted via GPO Box 1800Q, Melbourne Vic 3001, or at the 2nd Floor, 349 Collins St, Melbourne.

NEWS digest

4¾-digit LCD multimeter

The Thurlby 1503 4¾-digit LCD multimeter is being introduced by Parameters Pty Ltd at a price more commonly associated with 3½-digit meters.

The 1503 has a scale length of 32 768 counts (±15 bits); this extra resolution enables it to monitor a 1 mV change in a 30 V power rail, for example, when a 4½-digit meter would be limited to 10 mV and a 3½-digit meter to 100 mV. The high resolution also virtually eliminates inaccuracy caused by digitising error.

Thirty measuring ranges are provided, plus diode test and frequency measurement functions, and the instrument is claimed to have good noise rejection and a high sensitivity. Primarily intended as a laboratory instrument, the low power circuitry nevertheless gives it 200 hours of operation from batteries.

For further information contact Parameters Pty Ltd, PO Box 573, Artarmon NSW 2064. (02)439-3288.

Battery technology '81

A one-day seminar on electrical batteries will be held at the Faculty of Military Studies of the University of New South Wales at the Royal Military College, Duntroon, on Tuesday, 10 November, 1981.

Some twelve papers will be presented from industry, research establishments and the Department of Defence. Topics to be covered range from the characteristics of carbon-zinc primary batteries, through present practice of rapid charging of nickel-cadmium cells and recent progress in lead acid accumulator design, to lithium storage batteries for solar energy.

The seminar is directed mainly to batteries now available or going into production, and should be of particular interest to those concerned with the design of battery-operated equipment or battery procurement.

The conference is open to anyone, although accommodation is limited, and the $15 fee covers registration and a bound copy of all papers, which will be sent prior to the conference to all who register.

Further enquiries can be addressed to: Mr. C.G.J. Streatfield, Department of Electrical Engineering, Royal Military College, Duntroon ACT 2600. (062)66-3583 or 66-3707.

Popular transformers from Rod Irving

Rod Irving advises that he is now stocking three low-voltage transformers that deliver popularly required voltages and currents, all listed at competitive prices.

The R-2851 has a 12.6 V centre-tapped secondary rated at 150 mA. Next in line is the R-2155, which has a multi-tap secondary that provides 6.3, 7.5, 8.5, 9.5, 12.6 and 15 volts at 1 A. Last is the R-6672, another multi-tap transformer, which delivers 15, 17.5, 20, 24, 27.5 and 30 volts at 1 A.

Further details from Rod Irving Electronics, 425 High St, Northcote 3070 Vic.

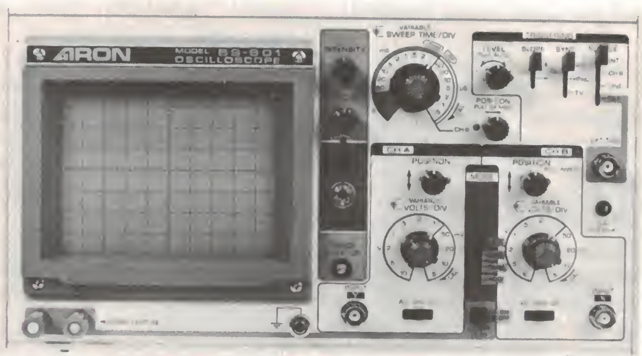
Aegis and FRL sign agreement

Aegis Pty Ltd of Melbourne has been appointed sole Australian agent for Fisher Research Laboratory Inc of the USA.

FRL has specialised in underground metal detection for fifty years, and were granted the first metal detector patent in 1937. Their industrial products include pipe and cable locators, cable fault locators, water leak detectors and water level indicators. Aegis will also distribute FRL's consumer lines, which include the 'M-Scope' treasure and gold detector.

Alan Bradley, Marketing Manager for Aegis, recently visited FRL in Los Banos, California, and spent several days in practical field work associated with the application of Fisher underground metal detection equipment. This experience should help Alan to provide full back-up support for Australian users of Fisher equipment.

For further information contact Aegis Pty Ltd, 141 Christmas St, Fairfield Vic. 3078. (03)481-1422.



Component-checking 'scope

Aaron Corporation recently incorporated a new test feature into their 20 MHz scope, the BS601, available from Elmeasco.

The BS601 is a dual-trace 5 mV/div instrument said to be ideal for service, TV and digital work. Its unique feature is the front-panel provision of terminals for checking passive components. A test signal of 2 mA maximum is applied to the component and a corresponding digital display produced on the screen.

Further details on the BS601 are available from Elmeasco Instruments Pty Ltd, PO Box 30, Concord NSW 2137. (02) 736-2888.

New Beckman multimeters

Warburton Franki recently announced the introduction of two new Beckman bench-top 3½-digit multimeters to supplement its line of handheld portables.

These two new meters, designated the Tech 350 and Tech 360 meters, are designed for use by electronic engineers, technicians and hobbyists.

Both feature 12 000-hour battery life, 0.01 ohm resolution, diode and transistor check, high overload protection, visual and audible continuity selection, 0.1% basic dc accuracy, and a single rotary switch that selects 31 ranges in eight different functions.

The Tech 350 is an average responding meter. The Tech 360 is a true RMS meter with built-in temperature measuring capability.

For further information contact your local Warburton Franki office.

Cool it, man!

There's no longer any need to get hot under the collar about cooling problems since Cambion introduced their low-cost thermoelectric cooling modules.

Distributed locally by Electronic Development Sales, these modules have a wide range of uses. You can make a water cooler, refrigerator, cold source, etc, from these simple packages.

Basically, they consist of a semiconductor junction that pumps heat from one face to another when a bias voltage is applied. This is known as the 'Peltier Effect'.

The ability of these devices to get rid of heat is truly amazing. Take the Cambion module type 801-2003-01-00-00, for example (try saying that in one breath!). Driven from an 8 Vdc source, it will draw around 5.5 A and has a maximum heat pumping capacity of 27 watts or greater. The maximum temperature difference between the faces of the module can be 60°C or greater and the hot side temperature may be 50°C. Not bad for a module that measures only 32 mm square by 3.8 mm thick!

Cambion have published a 28-page application notes manual that is chock-full of theoretical and practical notes if you're interested in exploring the subject of thermoelectric temperature control.

Further information can be obtained from Electronic Development Sales Pty Ltd, 92 Chandos St, St. Leonards (P.O. Box 217) NSW 2065. (02) 438-2500.

ERRATA

The ETI-154 Logic Pulser Probe in the July '81 issue has a designation error on the circuit diagram on page 55. IC1a is shown as an inverter where it is actually connected as a buffer. The output is pin 3 (goes to R3).

Seminars for school electronics teachers

Royston Electronics, who have some twenty years' experience in electronics production, are now making their knowledge available to teachers concerned with electronic projects in schools.

This will be done by means of a series of seminars, to include printed circuit board fabrication, etching, drilling, etc; the use of hand tools and work holding devices; solderability and soldering techniques, etc, etc.

Whilst Royston Electronics are involved with the highly sophisticated high-volume equipment now used in industry, the seminars will include demonstrations using the high-quality/small-volume equipment suitable for use by teachers in the classroom environment. This means that the techniques can be duplicated for the benefit of students.

Enquiries regarding the seminars should be directed to Mrs. P. Fleming, Royston Electronics, 27 Normanby Road, Notting Hill Vic. 3168, (03)543-5122, or Mrs. K. O'Regan, Royston Electronics, 15/59 Moxon Road, Punchbowl NSW 2196, (02)709-5293.

Automatic LCR bridge from AWA

The North Ryde division of AWA now has available an automatic digital bridge for measuring inductance, capacitance, resistance and Q.

The AIM LCR Databridge 401 is an auto-ranging auto-function bridge which is said to need a minimum of operator intervention to obtain fast, accurate readings of LCR and Q. Two measurement frequencies, 100 Hz and 1 kHz, and parallel or series circuits are available to the operator, and if the value being measured is too large or too small the display will show 'or' (over range) or 'ur' (under range).

Range indication is by nine LEDs, showing pF, nF, μF, Ω, MΩ, μH, mH and H. When measuring Q all LEDs are blanked.

With a basic accuracy of ±0.25% of the reading, the ranges are: 0 to 100 MΩ, 0 to 9999 H, 0 to 9999 μF and Q 0 to 99.

For further information contact Amalgamated Wireless (Australasia) Ltd, 422 Lane Cove Rd, North Ryde NSW 2113. (02)887-7111.

Static protection for benches and desks

Static-dissipative desk and bench covers of soft vinyl to protect microcircuit products from static electricity damage during production or in use are now available from Royston Electronics.

The top side of this 'Stat-Mat' is textured to prevent eyestrain from glare and to keep computers, terminals, word processors and other microcomputer-based equipment from sliding. 'Stat-Mat' also has a layer of continuously conductive vinyl laminated between two layers of soft vinyl. This prevents deterioration of static protection qualities from water, cleaning solvents or surface abrasions, and prevents sloughing of particles, making it usable in clean rooms.

Because the electrically conductive material is a homogenous mass conductor rather than a scrim, conductivity is greater and cannot be broken by tearing.

Colours are light blue and beige. The covers are available in 60 cm and 120 cm widths, cut to any length up to 100 feet.

Further information is available from Royston Electronics, 27 Normanby Road, Notting Hill Vic. 3168, (03)543-5122, and 15/59 Moxon Road, Punchbowl NSW 2196, (02)709-5293.

STC-Cannon to distribute Hitachi semiconductors

STC-Cannon Components Pty Ltd has become a distributor for Hitachi semiconductors in Australia.

A full range of Hitachi's 6800 CPU and peripherals will be available off the shelf at all STC-Cannon sales offices throughout Australia.

The director of marketing of STC-Cannon Components, Mr Brian Maloney, said the Hitachi products would be a significant and complementary addition to the extensive range of semiconductors handled by STC-Cannon.

Analogue memory modules go digital

A new range of analogue memory modules from Xebec Co Ltd is now offering indefinite analogue input signal value retention in the HOLD mode.

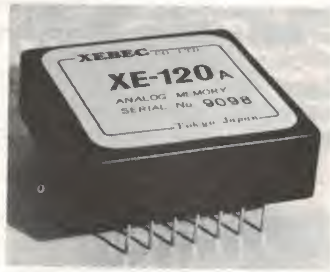
This is achieved by converting the analogue input signal into a digital signal inside the modules, all internal signal processing being done in the digital form. The output signal is again an analogue signal obtained from the digital signal by D/A conversion.

The modules can be used simply as analogue memories or used to construct a feedback control loop for controlling analogue signals. If used in a control application the response speed of the module can be adjusted externally, and the required resolution determined by the choice of modules.

All units have memory capability in the event of momentary power failure and, if using the non-volatile option, this is extended to about one year without the use of batteries!

These modules feature full pin compatability between the 8, 10 and 12-bit units.

For further information contact Alfatron Pty Ltd, 1761 Ferntree Gully Rd, Ferntree Gully Vic. 3156. (03)758-9551/758-7581.



OUR BINDERS ARE BIGGER!

That's because ETI is bigger every month, on average, than any other Australian-published electronics magazine, and 12 issues will not fit in commonly available binders.

You can just fit the 1979 issues in the 'old' binders, but 1980 is a different story! And 1981 will be the same. So we've arranged to have bigger binders made to take the increased thickness of ETIs, as we know that many of you good readers like to keep your past issues.

If you too would like to keep ETI's "... articles of lasting interest" protected and in order, then our sturdy binders, finished in brown vinyl with the magazine's title printed in gold on the spine, can be obtained for a mere $6.10 by NSW readers or $7.50 for readers in other states, post paid. Send your cheque or money order to 'ETI Binders', ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011.

RESULTS: ETI/Radofin Teletext Contest

This contest, featured in our July issue, attracted quite a pile of entries from all over the country. The five multiple-choice questions certainly sorted out who was on the ball with their homework — all you had to do was search back through your 1980-1981 ETIs to find the answers. Quite a few entrants managed to do this successfully, so we were left with judging answers to the 50 word essay question. The most imaginative answer, we thought, came from:

R.S. COX of HAMILTON SOUTH NSW

Congratulations, Mr Cox, your Radofin Adam 180 Teletext Adaptor, courtesy of Radofin Electronics (Aust.), is on its way to you.

Here are the correct answers to the five multiple-choice questions followed by the winning essay on which feature of Teletext appealed most to Mr. Cox.

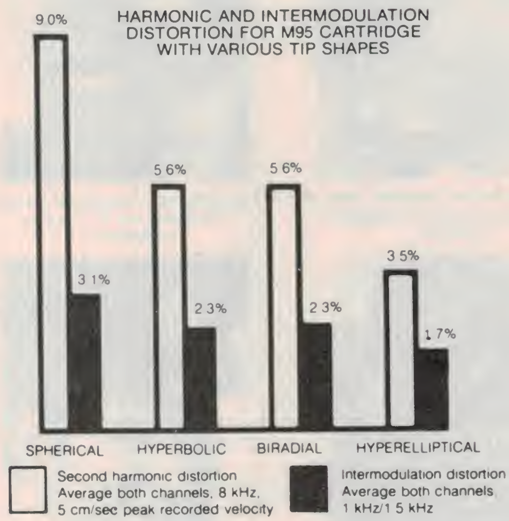
1. Are Teletext signals synchronised with the TV line frequency? **Yes.**
2. Can the Teletext display be superimposed over the normal TV picture when using the Radofin adaptor? **Yes.**
3. The release of the Radofin Adam 180 Teletext Adaptor was announced in which issue of ETI this year? **April.** (Radofin's first advertisement, announcing the unit, appeared in March, and so those answering March were counted as correct).
4. When did Teletext officially go into service in Australia? **4 February 1980.**
5. About when did TV stations first start test transmissions of Teletext signals? **March 1977.**

"Teletext appeals because it extends the use of the domestic television set to an information system which combines the immediacy of broadcasting with the longer-term accessibility of a newspaper."

fact: dramatic freedom from distortion comes to a mid-priced cartridge: the new Shure M95HE...

an affordable, audible improvement

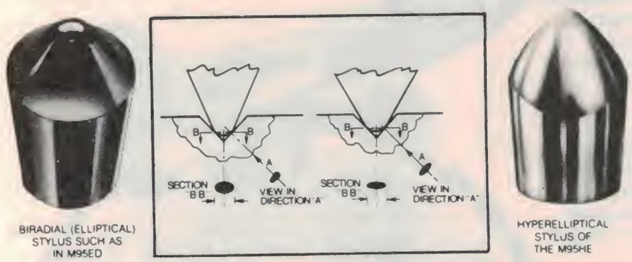
One of the critically acclaimed advances introduced in Shure's incomparable V15 Type IV pickup is its revolutionary and unique distortion-reducing Hyperelliptical stylus. Now, you can enjoy this standard of sound purity in a new, ultra-flat frequency response, light tracking, high trackability cartridge that will not tax your budget: the new Shure Model M95HE.



a measurable drop in distortion

As a result of the optimized contact area of the Hyperelliptical tip, both harmonic distortion (white bars in graph above) and intermodulation distortion (black bars) are dramatically reduced.

the Hyperelliptical stylus tip



BIRADIAL (ELLIPTICAL) STYLUS SUCH AS IN M95ED

HYPERELLIPTICAL STYLUS OF THE M95HE

The Hyperelliptical nude diamond tip configuration represents a significant advance in tip design for stereo sound reproduction. As the figures show, its "footprint" (represented by black oval) is longer and narrower than the traditional Biradial (Elliptical) tip-groove contact area. Because the Hyperelliptical footprint geometry is narrower than both the Biradial and long-contact shapes such as the Hyperbolic, it is pre-eminent for reproduction of the stereo-cut groove.

upgrade your present M95 If you already have a Shure M95 Series Cartridge, you can improve its freedom from distortion right up to the standards of the new M95HE cartridge simply by equipping it with a Model *N95HE* stylus. The cost is extraordinarily low — yet the difference in sound will be immediately apparent. Takes only seconds to install — requires no tools whatsoever.

M95HE cartridge & N95HE stylus

SHURE®

AUDIO ENGINEERS P/L
342 Kent Street
SYDNEY 2000 NSW

AUDIO ENGINEERS (Qld.)
51A Castlemaine Street
MILTON 4064 Qld.

NOMIS ELECTRONICS P/L
689 South Road
BLACK FOREST 5035 SA

AUDIO ENGINEERS (Vic.)
2A Hill Street
THORNBURY 3071 Vic.

ATHOL M. HILL P/L
33 Wittenoom Street
EAST PERTH 6000 WA

HAWKINS AE 142FP

Join the people who have made the Air Force their life

"I've seen a lot of Australia. Now I'm looking forward to being posted overseas."

"I enjoy being a member of the team that keeps our F111's fully operational."

"You're trained to work on some of the most advanced equipment in the world."

"The opportunities for promotion with more pay and responsibility are there."

"You don't mind working hard if it's for a specific purpose like the country's security."

"At 23 I found myself promoted to Section Head. That kept me on my toes."

"It isn't all work I have time to relax and play my favourite sport."

"The training has set me up with a career for life — it's really professional."

The satisfaction and rewards are immense.

A new lifestyle. New friends. New interests. New qualifications. New places visited.

And you start on full adult pay too! After training we'll pay you even more! Then there's four weeks annual leave and the opportunity to continue studying for higher qualifications. So if you want to reach a higher rank, it's up to you.

It's not an easy life.

Success demands application. A disciplined approach to your work. What's more, you'll be part of a special team that's proud to wear the Air Force uniform.

Normally you'll work a five day week. But at times we expect you to do extra duties.

You must be prepared to join us for a minimum of six years and be prepared to live and work on any one of our bases.

Your future.

Is it in Flight Systems, Propulsion Systems, Air Frames, Telecommunications, Engineering, Administration, Weaponry, Supply or Motor Transport?

The choice is vast. The scope unrivalled.

So if you're aged between 17 and 34 years (17 and 43 years if no trade training is required), an Australian citizen or meet our nationality requirements, we would like to meet you. (People with civilian qualifications and experience are most welcome to apply.) Enquiries are also invited for Apprenticeships.

Today, walk into the Air Force Recruiting Office nearest you and have a chat with a Careers Adviser. The address is in the phone book. It could be your first important step to an exciting new career.

Alternatively send the coupon or phone for the facts:

Brisbane: 226 2626	Townsville: 71 3191	Sydney: 212 1011
Wollongong: 28 6294	Parramatta: 635 1511	Canberra: 82 2333
Hobart: 34 7077	Adelaide: 212 1455	Perth: 325 6222
Melbourne: 61 3731	Newcastle: 2 5476	

To:
RAAF CAREERS
ADVISER. G.P.O. Box XYZ
in the capital city nearest you
Yes! I am interested in an RAAF career. Please send me full details.

Name

Mr/Miss ....

Address ....

State .... Postcode ....

Date of Birth: ..../......../......

RG.417.FP.11ET

You're somebody in Today's Air Force

Authorised by Director-General Recruiting Dept. Defence

RG.417.FP.11ET

NEWS digest

First for HP scientists

Scientists and engineers of Hewlett-Packard laboratories in Palo Alto, California, have revealed in four technical papers a new electron beam lithography system that promises, using direct writing, to make production quantities of ICs of greater complexity than any yet seen. The system appears to be the first of its kind.

New levels of speed and accuracy were cited by the firm as reasons for expecting the system to make so large a forward step in the integrated circuits 'art'.

The ability of the HP system to produce patterns of extreme complexity at high production rates rests largely upon the achievement of a 600 nanoampere, 0.5 micron beam that can be blanked at a 300 MHz rate (i.e: exposing 1 pixel every 3.3 ns) while the beam is placed anywhere in a field of view of 11.7 x 11.7 cm, with accuracy of ±0.125 micron.

According to HP, there is every indication that ICs of 1 micron geometry will be routinely producible by the equipment. A beam-produced 2.6 GHz surface acoustic wave resonator with 0.3 micron lines and spaces has been demonstrated.

The HP E-beam lithography system is documented in detail in the May 1981 issue of the Hewlett-Packard journal. Copies are available from Hewlett-Packard Australia Pty Ltd, PO Box 36, Doncaster East Vic. 3109.

Vicom lab power supply

Vicom International has available a new laboratory-type dc power supply which incorporates pulse switching, thereby eliminating bulky transformers.

Produced by the Daiwa Corporation of Japan, this power supply has variable voltage output between 9 and 15 volts, and a maximum current rating of 30 amps.

Using Daiwa's crossed-needle indicating meter system, voltage output and current are automatically read, and wattage is additionally read on the calibrated scale at the point where the needles intersect. The efficiency of the supply is claimed to be 75%, with voltage regulations better than 0.5% at the maximum current of 30 amps.

Further details and pricing are available from Vicom International, 68 Eastern Rd, South Melbourne Vic. 3205. (03) 62-6931, or the Vicom Sydney office on (02)436-2766.

Texas Instruments report

A new 16-page application report, 'Power Transistor Voltage Ratings and RBSOA Curve', is available free from Texas Instruments sales offices throughout Asia and Australia.

The new report (SCA-202) discusses experiments which reveal how power transistor-measured voltage characteristics, particularly VCED (SUS) and VCEX (SUS) and the reverse bias safe operating area (RBSOA) verified capability, actually relate to a device's high voltage switching capability.

Test experiments included in the report are commutating switch test, unclamped inductive load energy test, clamped inductive test method, breakdown voltage test and the reverse bias safe operating area test.

Report SCA-202 is available from TI's sales offices in Sydney, Melbourne, Singapore, Hong Kong, Manila, Taipei and Seoul.

Has pen, will write

The documentation supplied with electronics instruments, devices or kits is an important part of the overall 'package', and a product's success can stand or fall on the documentation — as pointed out in the Editorial of the September ETI.

Teknidata Services was set up in mid-1980 by Andrew Kay, a self-employed technical writer, with the aim of providing a professional, personal service in the field of technical comunication. Andrew's experience includes a solid practical background as an electronics technician/ technical officer in communications, process control, data logging, laboratory instrumentation and bio-electronics.

This practical background, coupled with the last nine years as a professional technical writer working on military and commercial handbook research and preparation, enables Teknidata to offer a genuinely useful service in the preparation of all sorts of technical documentation, Andrew claims.

The services are offered either on a 'whole job' basis or 'in-house' at the client's premises, and extend to much more than just the writing component. Painstaking research, careful validation and the willingness to see the job through to the 'nitty-gritty' end of hassling with printers, layout artists, typesetters and the like are, according to Andrew Kay, the keys to a successful publication project — be it a simple technical sales brochure or a complex, multi-volume manual.

At present the company offers the following documentation services:

- research, writing, editing and production of customer-oriented documentation — i.e: sales brochures, ad copy, product specifications, operating and technical handbooks, parts lists and catalogues;
- kit-assembly manuals, fault-finding guides, detailed procedural instructions of all kinds;
- preparation of company and personal resumes, technical proposals, quotations;
- project management of documentation jobs — i.e: co-ordinating and controlling the preparation, illustration, paste-up, photography and printing for a publication or leaflet.

For further details, quotes, etc, contact Andrew Kay at Teknidata Services Pty Ltd, (02)519-3749.

New switch guide

The Components Division of IRH has released a new four-page guide to the Fujisoku range of subminiature toggle and pushbutton switches. Most types are available for immediate delivery in quantity.

Toggle types include waterproof, flat, locking, vertical and right-angled mounting switches, and pushbutton switches are available in conventional and waterproof versions.

The guide (SW2/1981) also gives details of accessories, including coloured caps and mounting hardware, plus full electrical and mechanical specifications.

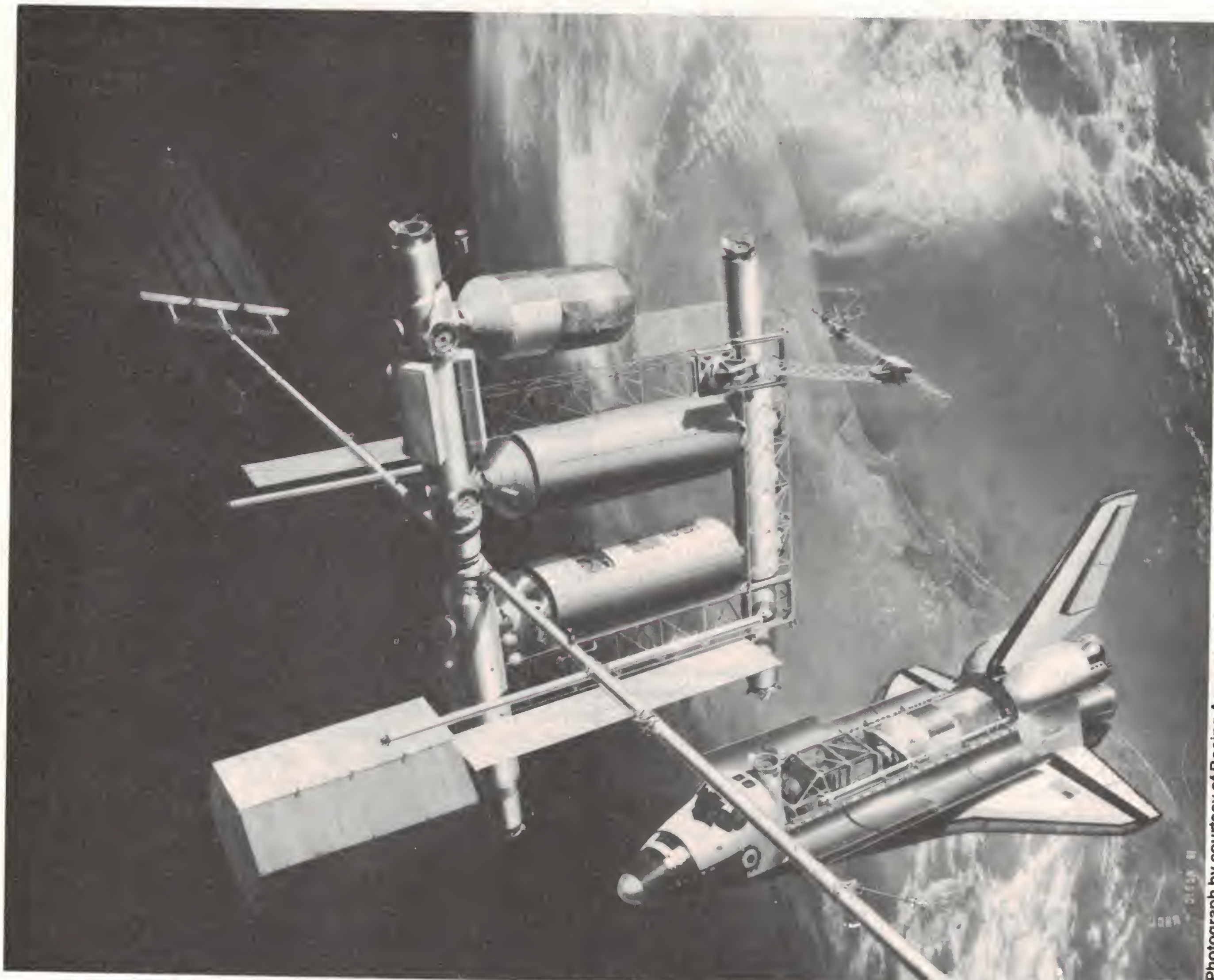
Copies of the guide are available from IRH Pty Ltd, 53 Garema Circuit, Kingsgrove NSW 2208. (02)750-6444.

Martin de Launay in Kingswood

Martin de Launay Pty Ltd, wholesalers and importers of electric, electronic and mining supplies, recently opened a new branch in Kingswood, managed by Mr. Arthur Higlett.

The address is Unit 1, 4-6 Phillip St, Kingswood NSW 2750. (047)32-2081. Hours are Monday to Friday, 7.30 am to 5 pm.

Permanently orbiting spaceport for NASA



Photograph by courtesy of Boeing Aerospace.

A spaceport which would permanently orbit the earth at an altitude of some 200 to 250 miles has been designed by Boeing Aerospace as the first phase of a study for NASA.

Such a space operations centre would be permanently manned, with the crew members staying there for about 90 days before returning to earth. The design includes two 'habitat' areas which would serve as living quarters, each being roughly the size of a large mobile home, containing command control, food preparation, health maintenance and recreation areas for a normal crew of eight people.

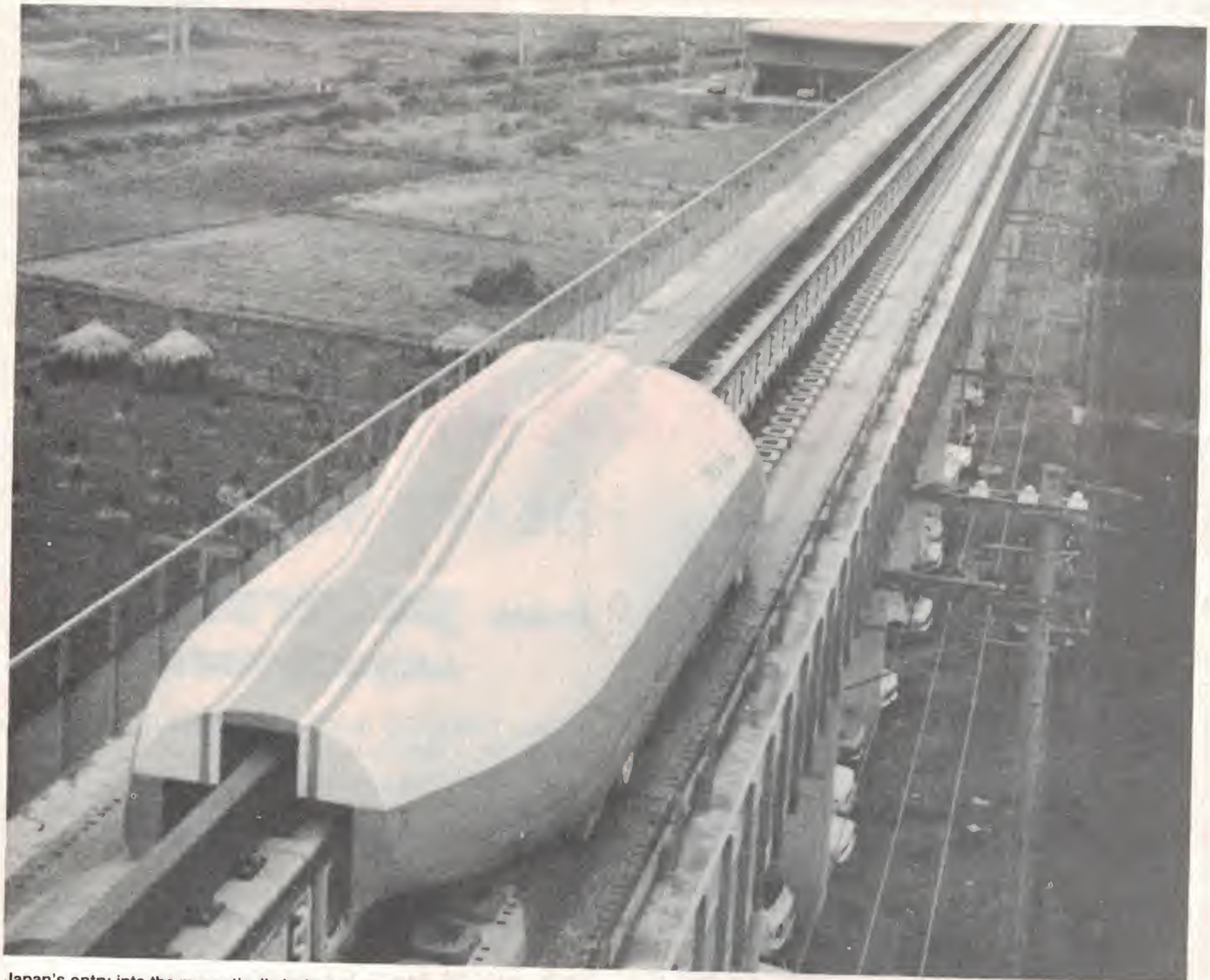
The aim has been to develop an orbiting facility with mainly operational rather than only scientific functions. The unit would serve as a staging point, rather like a base camp in a mountain climb. Large orbiting systems could be constructed and checked out at the centre, whilst free-flying satellites could be tended and space-based vehicles serviced, launched and recovered.

The modular construction of the spaceport is well shown in the photograph, and the following components should be easily made out:

1. Flat panel radiator — the long, striped panel adjacent to the orbiter.
2. A large hexagonal hangar for servicing and storing spacecraft.
3. Two cylindrical modules containing propellant, batteries, power processing units, oxygen and nitrogen.
4. A solar array attached to a long boom. A second array (not shown) is at the other end of the boom and together they provide power for the spaceport.
5. A shorter logistics module (partially covered with thermal insulation), which serves as a storeroom for consumables such as food, water and hydrazine propellant.
6. Track or truss structure and 'cherry picker' crane used for handling spacecraft.
7. A tube-like docking module (adjacent to the base of the crane) used primarily for docking spacecraft or building other structures. Here the Space Shuttle Orbiter can be seen in docking position.

If NASA decides to order such a spaceport, it could be constructed in the late 1980s, initially for use by a crew of only four.

Brian Dance



Japan's entry into the magnetically levitated concept is shown on its test track. This prototype has achieved speeds up to 500 km/h. (Photo: courtesy of Japanese National Railways.)

Magnetic levitation for future transport?

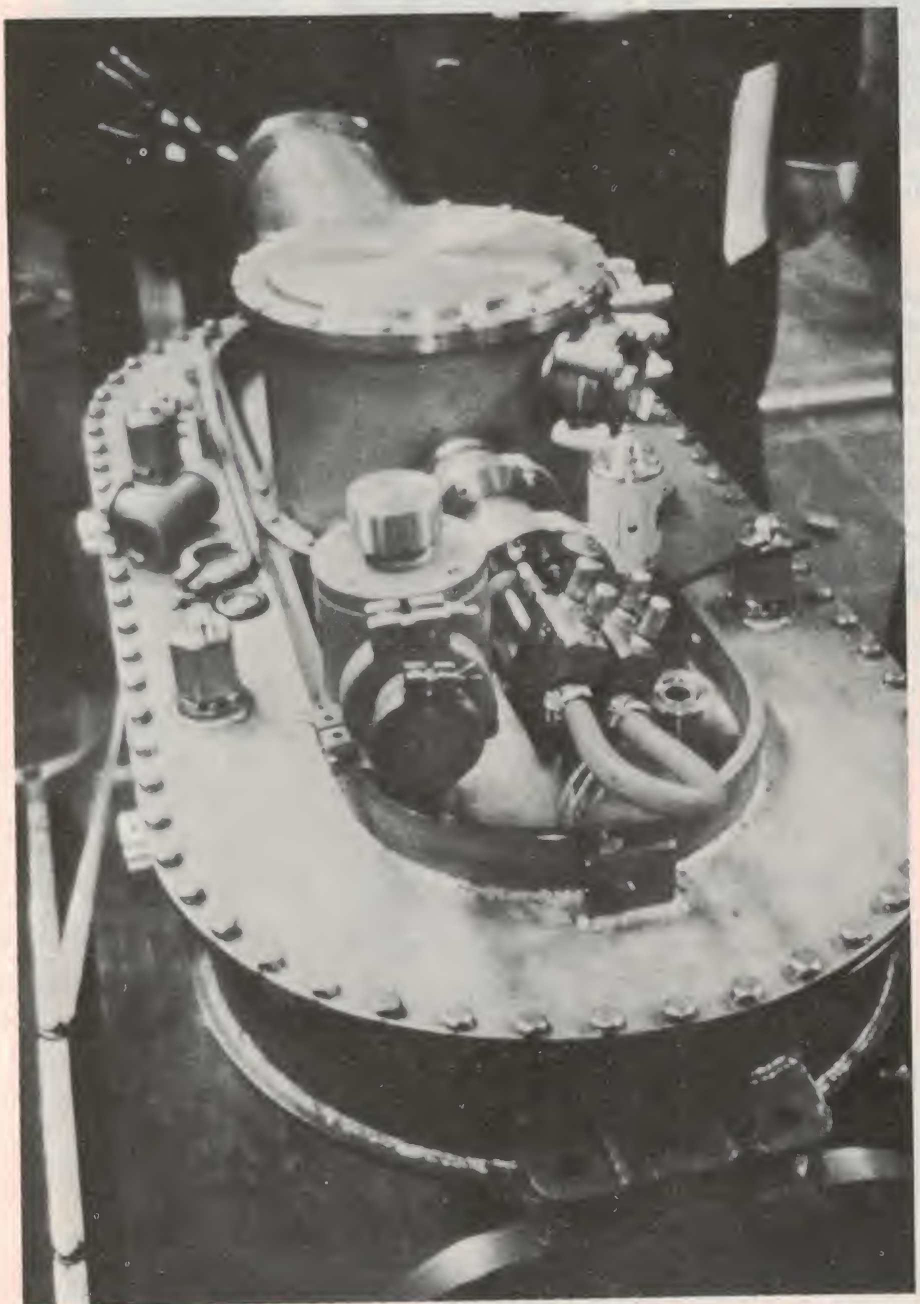
Dwindling energy supplies are making the concept of a magnetically driven train appear attractive. The Canadian National Research Council's Division of Mechanical Engineering recently completed a study on the possibilities of such a system.

HYDROCARBON FUELS, the mainstay of today's travel, are in dwindling supply. Fuel price increases are front-page news and real cost of transportation is coming under close scrutiny. Airlines, for example, are finding the cost of flying a commercial jet aeroplane from Sydney to Canberra is proportionally higher than from Sydney to Perth. Fuel-expensive take-offs and landings must be offset by higher passenger revenues on such short hauls. Beyond the flight, the passengers themselves frequently must add the cost and time of further transport to city centres. Suggested alternatives, such as short take-off and landing (STOL) aircraft, air cushion

vehicles (ACVs), or high speed trains have been proposed as interim solutions. Yet another alternative, a magnetically levitated vehicle (MAGLEV), has been under evaluation by the university community, industry and the Canadian National Research Council.

To properly understand what a magnetic levitation system is, it is necessary to recall the toy magnets of childhood and the discovery that one magnet makes another 'float' in air. When engineers coil a wire around an iron core and apply an electric current, the power of the resultant magnet is increased and the toy becomes a tool.

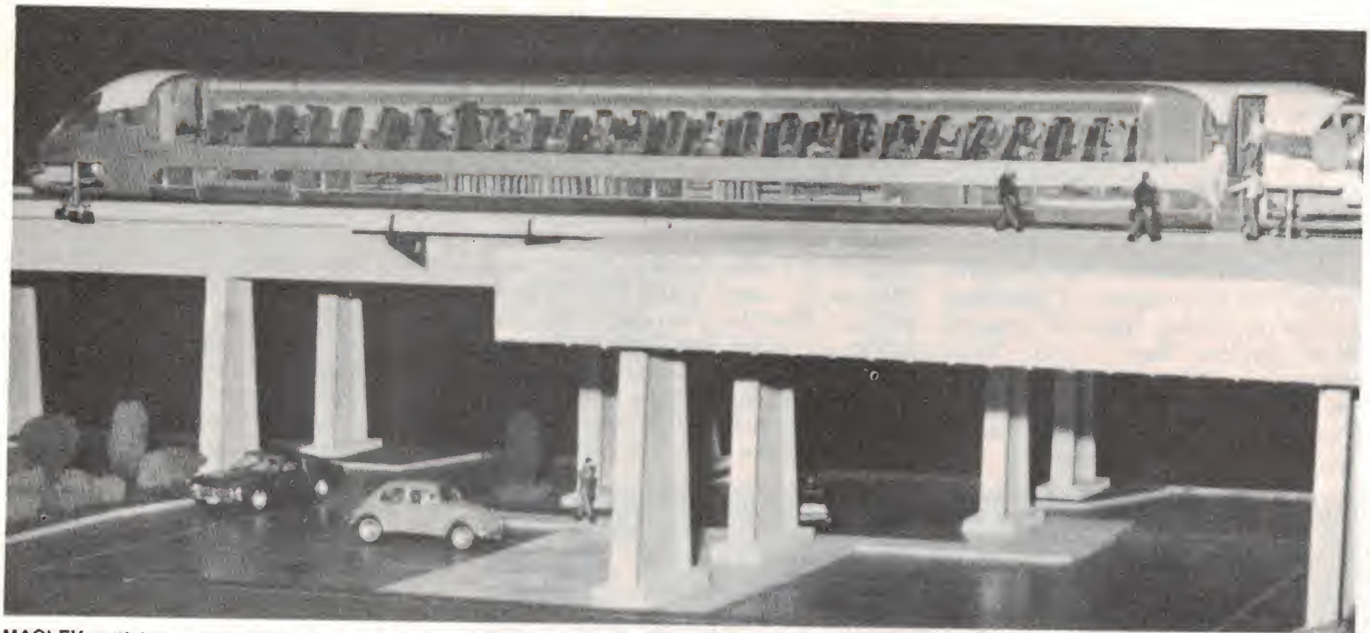
Early in this century, researchers attempted to use the electromagnet concept to 'lift' vehicles, with the intention of providing frictionless, high speed transport over moderate distances. However, these early studies indicated that the necessary technology could not create a commercially feasible system. As a result, the idea of using magnetic levitation for travel was shelved for many years. Today's technology, however, in particular the advent of superconducting wires, has allowed engineers to develop the earlier ideas, and to conceive a complete system based on repulsion lift (rather than the somewhat older attraction lift concept). The Canadian NRC has been investigating a repulsion MAGLEV for some years.


Prototype West German superconducting magnet for MAGLEV vehicle. (Photo: Siemens Research Laboratories, German Federal Republic.)

W.F. Hayes, of the Division of Mechanical Engineering, authored a report examining the engineering feasibility of a high speed MAGLEV system. In summarising the events leading to the conceptual study, Hayes states: "There were numerous threads to tie together in establishing the practicality of such a system. We started at the bottom — the track. Several configurations have been considered, both here and abroad — but in Canada the chief problem is snow on the tracks. After a number of winter tests of full-sized track forms, a flat track was shown to be best, as it is self-cleaning — the snow simply blows off before packing into ice. At the beginning, therefore, we established that the clearance between track and vehicle could be generous, which allows us to use conventional reinforced concrete construction methods and avoid expensive close tolerance techniques.

"Track design was followed by an investigation of the type of vehicle that would work best on the flat track," continues Hayes. "Instead of setting a figure on the number of passengers we should carry, we determined the most energy-efficient vehicle form and derived how many passengers it would carry. A relatively long, 3 m wide cross-section evolved; a width ideal for a first-class accommodation plan of two-by-two seating and economy class of two-by-three. At the same time, we performed a number of aerodynamic tests to determine the frontal shape best suited to our needs and, behold, we came up with what looked like a DC-9 without wings, stabilisers or engines. These studies also enabled a design team at the Council's Division of Mechanical Engineering to calculate anticipated weights, which showed that the MAGLEV train could carry twice the revenue load of a comparably sized aircraft. This proved to be a real breakthrough, demonstrating that MAGLEV could be revenue competitive with aircraft on short haul (500 km) runs."

MAGLEV propulsion methods remain a major design consideration. "Although early work concentrated on 'lifting' the vehicle," explains Hayes, "ideas on propulsion which could be successfully coupled with frictionless suspension were being investigated by design teams in a number of countries. The Americans initially proposed a gas turbine engine. That tied them to such problems as carrying fuel, reducing revenue payload weight, fire hazard, exhaust and noise pollution, with the added headache of engine maintenance ▶



MAGLEV model constructed by technicians at NRC's Division of Mechanical Engineering portrays the train taking on passengers and cargo at 'Ottawa' station. The model shows flat track cross-section and outrigger wheels deployed when train is stopped or operating at slow speeds. (Photo: Mansell Acres, DME Canada.)

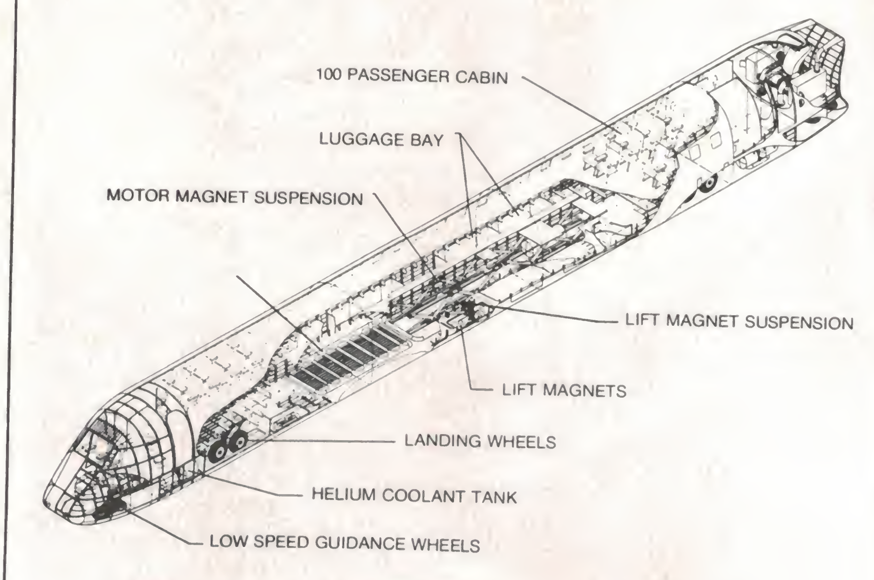
time. Other MAGLEV propulsion concepts have centred on linear electric drives."

The development of superconducting wires in the 1960s has permitted pursuit of more revolutionary drive concepts. Electrical conductors, cooled to close to absolute zero temperature, exhibit a sharp drop in resistance. To accomplish this, electrical wires are enclosed in a liquid helium environment, efficiently producing strong magnetic fields. These intense fields allow the vehicle to be lifted off the 'track' as well as providing the means to propel MAGLEV to its destination. For propulsion, a travelling magnetic wave is generated in windings in the track, which couples with the superconductors mounted in the base of the vehicle. The travelling wave then 'pulls' the vehicle along the track.

"A great deal of development has been done on superconducting linear magnetic drives in the last few decades," says Hayes. "German, Japanese and American scientists have examined the engineering problems with considerable success. Studies in Canada took place at Queen's University in Kingston, Ontario, during the early 1970s, on what is called a 'linear synchronous magnetic drive' for MAGLEV. The theoretical work done by a University of Toronto group and a full-scale experimental study of the drive at Queen's and NRC gave us a basis for our conceptual design of the system.

"Part of our study involved the investigation of 'fail-safe' requirements for the system," notes Hayes. "For example, the lift and drive magnets in the vehicle are cooled by jackets containing liquid helium. Should these cooling systems fail, the train will not run. That is one of our biggest problems — to come up with a highly reliable and lightweight refrigeration system. The Japanese have made great strides in cryogenics (low temperature engineering), and our report recommends further work in this area, especially in improving reliability."

If the superconducting magnet system for MAGLEV is in the realm of future technology, the rest of the system is in what can be called an 'off-the-shelf' state of the art. "Nearly all of the concept we proposed in the report is well within today's technological range," says Hayes. "Vehicle configuration is not only similar to present jet aircraft in external appearance, but a good many construction techniques in that industry could be applied as well. In fact,



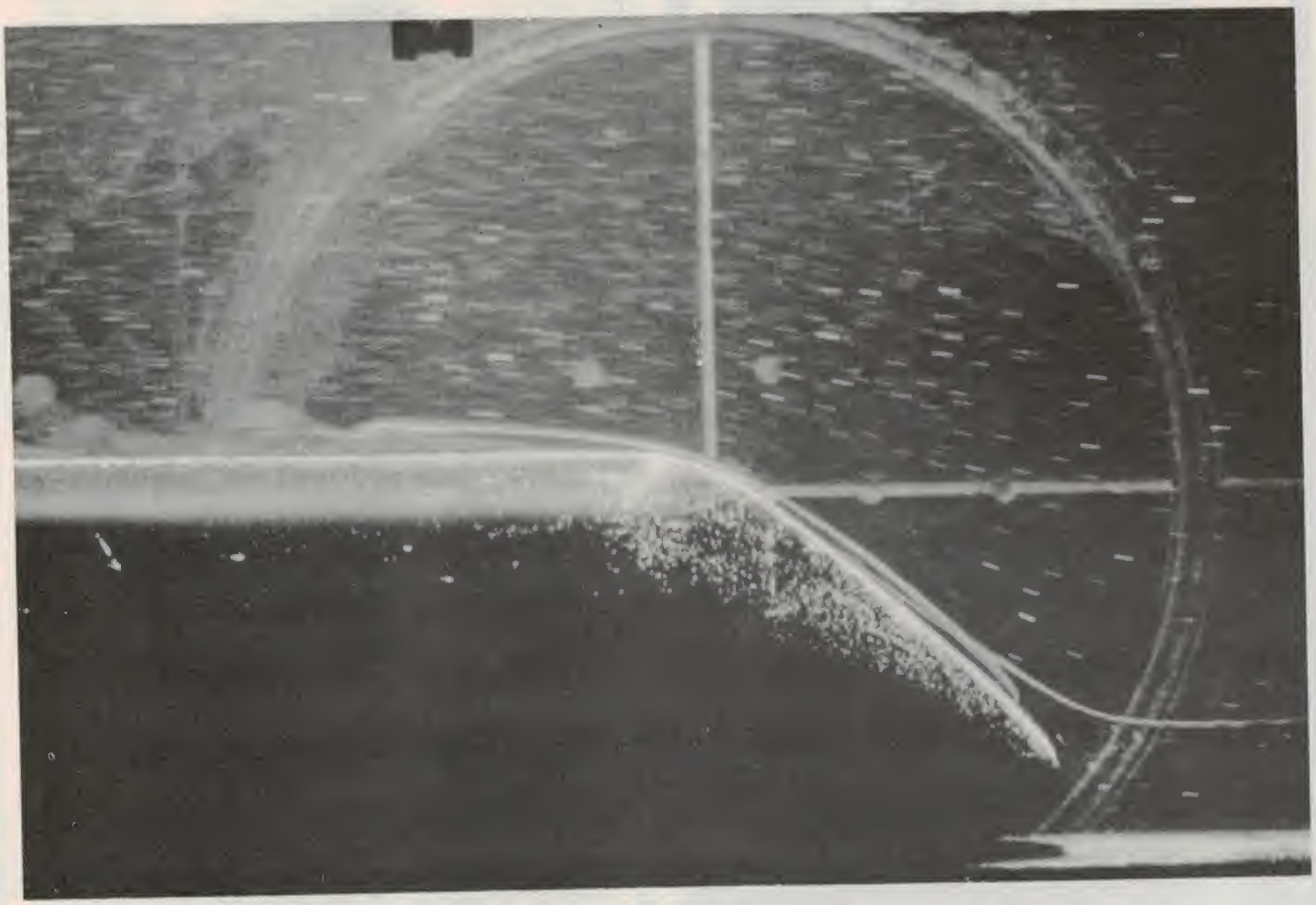
CANADIAN MAGNETIC LEVITATION VEHICLE DESIGN CONCEPT

the construction of a MAGLEV vehicle would be simpler than an aircraft and calculating the loads or carrying weights on MAGLEV is much easier than on aircraft."

Hayes and his team were able to demonstrate that a MAGLEV system for short hauls is technically possible within the foreseeable future — if such a system is desired. "But MAGLEV is not a transportation cure-all", he stresses. "Some very basic decisions will have to be made over the next few years. We've extended the concept of MAGLEV from a high-speed ground-level replacement for commuter aircraft to an energy-competitive system. However, we cannot dodge the fact that for MAGLEV to come into being, a massive outlay in capital will be needed. A completely elevated track system would have to be built, electric power networks installed, stations built and the vehicles constructed — a monumental effort."

A report is now being prepared on the economics of MAGLEV by the Canadian Institute of Guided Ground Transport under the sponsorship of the federal Ministry Transport Canada. The study group wants to know if the capital outlay to create a system operating in the Montreal-Ottawa-Toronto corridor will ultimately be offset by the revenue generated by passengers and freight anticipated over the short-haul route. "Our conceptual design study reflects some serious changes of attitude," concludes Hayes. "Where MAGLEV was initially an idea for high-speed inter-city commuter convenience, it now promises to provide high capacity transportation without seriously infringing on non-renewable energy supplies." ●

An outdoor view of the NRC-DME model, showing the deployed outrigger wheels and luggage compartments. (Photo: Pat Griechen, DME Canada.)



Another model of the MAGLEV undergoes aerodynamic testing at NRC's National Aeronautical Establishment testing facilities. Vehicle nose shape is critical at speeds up to 500 km/h. (Photo: George Dobrodzicki, DME Canada.)

A CAREER with DICK SMITH'S can start in our Mail Order Dept.

Our policy of internal promotion has proved the Mail Order Department to be the training ground for future Dick Smith Executives. Our informal company structure means you'll be encouraged to prove what you can do. Besides advancement within the department, people have moved into our advertising, retail, service & accounts departments.
Our next Managing Director could start in one of these positions:
ASSEMBLERS, PACKERS, INVOICE CLERKS, STOCK CONTROLLERS, TRAINEE MANAGERS.

Contact Ross Weeks, Mail Order Centre (02) 888 3200.

TRAINEE MANAGERS:

We need managers for the new stores we're opening right around Australia - and overseas. What better way to prepare for this than by training in a current Dick Smith Store. If you're between 18 and 30, have a hobby background in electronics and retail experience, give us a call. We'll probably place you in a store close to home (we have 21 stores - in most states).

Contact Mr Bob Johnson, Retail Supervisor (02) 888 3200 or ask your local store manager.

TECHNICAL SALES STAFF/ SPECIALISTS:

You could join our young sales team - or even be a specialist salesman if you have a particular interest. (Amateur Radio, Computers, etc). You'll be trained thoroughly in being a sales professional, and you'll be dealing with interesting people involved in electronics: just like you are at the moment!

Contact your local store manager.

STOCK CONTROLLER:

We now have a vacancy for a stock controller in our Kit Department. The prospective applicant must have a basic knowledge of electronics, plus experience in stock inventory and stock movement. Must be self motivated and work without supervision.

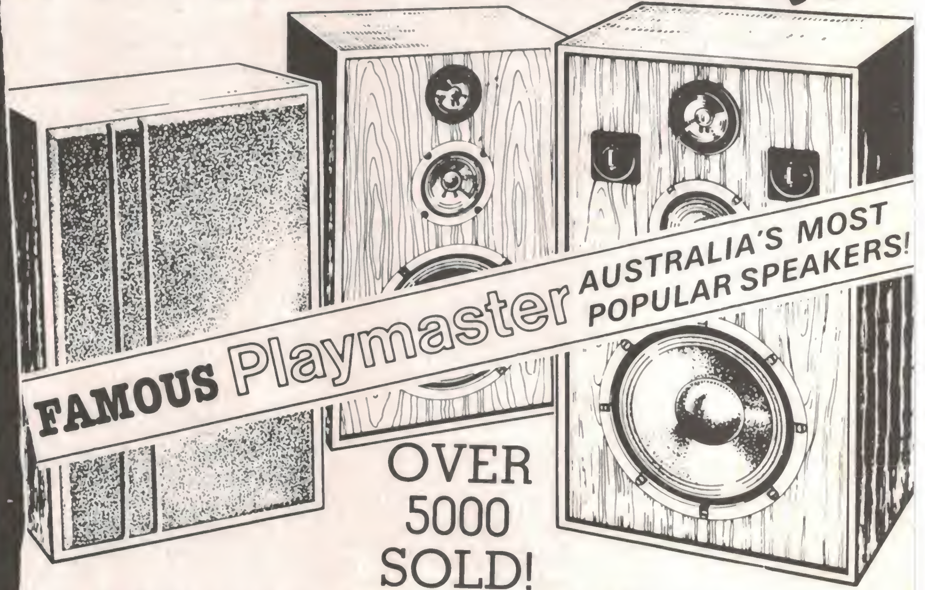
Contact Mike Rogers, Kit Centre Manager (02)888 3200.

SERVICE TECHNICIANS:

Our North Ryde (NSW) service centre needs technical experts in all categories: audio, RF digital . . . the opportunities for promotion are very, very good for the right people (our current National Service Manager started 'on the bench' just a few years ago!)
You'll be working in air-conditioned premises, with the latest in service aids. The pace is hectic - so we want people who don't need continual supervision.

Contact Gary Crapp, National Service Manager (02) 888 3200.

SAVE $100s ON QUALITY SPEAKERS

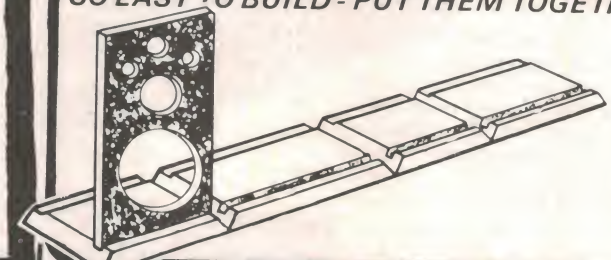


NOW LOOK AT THESE FEATURES:

- **NEW** Audio density board supplied with Innerbond 'wonder wool'.
- **NEW** Heavy duty construction - ribbed woofer.
- **NEW** Sealed mid range & tweeter to prevent cross frequency intermodulation.

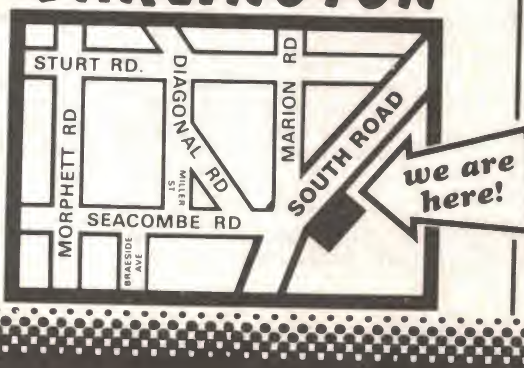
Even though these new model speakers with infinite baffle cabinet construction cost us considerably more, we will not pass the extra cost onto our customers. YOU REAP THE BENEFIT!

SO EASY TO BUILD - PUT THEM TOGETHER YOURSELF!



You don't need special tools, materials or skills, just a screw-driver & a tube of wood glue! The Dick Smith 'Playmaster' kit has all you need - precision manufactured so that everything just about 'falls in place'! You're saving on high labour costs - & getting a superb speaker system. Kits come complete with detailed instruction manual

OPENING SOON IN DARLINGTON



THIRD OFF!

SPECIAL OFFER CLOSES 31st DEC.

ALL KIT PRICES PER PAIR!

200mm	250mm	300mm
NORMALLY	NORMALLY	NORMALLY
SPEAKER KIT C-2046 $89.50	SPEAKER KIT C-2044 $149.00	SPEAKER KIT C-2042 $175.00
BOX KIT C-2626 $82.00	BOX KIT C-2624 $115.00	BOX KIT C-2622 $139.00
TOTAL: $171.50	TOTAL: $264.00	TOTAL: $314.00
NOW $114.33	NOW $176.00	NOW $209.33

WATCH THIS SPACE!

Did you miss out on our BELOW COST SPECIAL? LAST MONTH:

13pc. Drill Kit

ONLY $1.77 T-4800

WAS $2.95 SAVE $1.18

NEXT MONTH: ? ? ?

Don't buy an almost superseded 18 chan. CB Radio!

A recent announcement by the Minister for Communications recommends that 40 channel 27MHz CB radios be licensed from the 1st January next and that 18 channel units be phased out.

DICK SMITH NOW HAS 40 CHANNEL CB UNITS WITH HIS EXCLUSIVE 'LICENCE GUARANTEE'

All 40 channel units now being sold by our company are guaranteed to meet the new specification and be fully licensable from January 1st, 1982.

NOTE: If for any unforeseen reason the new 40 channel specification is changed, we will modify these units to the new specifications at no charge to the purchaser.

'PRO SPEC' SEMICONDUCTORS

Simply selling the cheapest semi-conductor doesn't always win you the most friends. Following many requests from hobbyists & professionals alike, we are now purchasing on quality rather than price.
Our prices are still way below most of our competitors & we are now confident on quality that we offer a 12 MONTH REPLACEMENT GUARANTEE (most others offer no guarantee on semiconductors).

40,000 CB'S SOLD!

STALKER IX SSB 40 CHANNEL AND ONLY

D-1712

$249.00

The Stalker IX has everything you'd want from a transceiver: auto noise limiter and blanker (ANL & NB), a bright/dim switch, plus an RF gain control & much, much more. A super transceiver - at a bargain price!

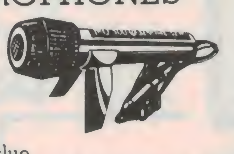
National Logic TTL Data Manual

Full data on typical TTL devices. A handy reference manual - a must for the workshop!

ONLY $9.95 B-4022

FANTASTIC SAVINGS ON THESE SENNHEISER MICROPHONES

SAVE up to 30%



DYNAMIC OMNI

DYNAMIC CARDIOID MIC

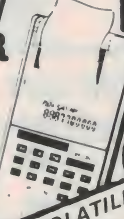
Both microphones represent outstanding value. Great for hi-fi or movie buffs. It's a better replacement for that old cassette microphone too! Complete with desk stand.

$19.95 EA.

C-1021 C-1020

NOW! POCKET SIZE

PRINTER/ CALCULATOR



This fantastic miniature calculator printer has Percentage, Square Root, Tab (floating decimal point) keys, Print/No print function etc etc. Outstanding value! (Paper to suit 60¢ Q-3021)

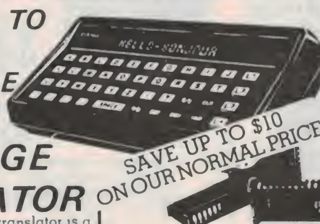
ONLY $67 NON VOLATILE MEMORY

Q-3020

WAY BELOW MANUFAC. COST

STILL TIME TO TAKE ADVANTAGE

CRAIG LANGUAGE TRANSLATOR



SAVE UP TO $10 ON OUR NORMAL PRICE

This brilliant language translator is a must for the businessman & overseas traveller. A great way to learn a second language. Has normal calculator functions, plus metric conversion as well (WAS SELLING FOR $250).

ONLY $59.95

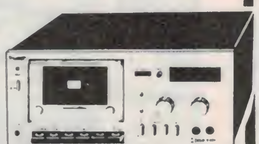
Y-1340

Modules:
Japanese(Y-1342) $14.50, German (Y-1343) $16.50, Italian(Y-1344) $14.50, Bar & Wine Guide(Y-1345) $10.00, Calorie Counter(Y-1346) $9.50, Phonetics(Y-1347) $9.50 Spanish(Y-1348) $16.50

BUY 3 & GET BAR WINE OR CALORIE COUNTER FREE!!!

LOOK AT DICK'S PRICE FOR A QUALITY METAL DECK

DOLBY DECK



We've made a huge scoop purchase of these incredible METAL cassette decks. Superb dolby sound on metal or chrome tapes. Features separate recording levels, LED VU meters. PLUS MUCH MORE!

DON'T PAY $199 OR MORE!

ONLY $115

A-3503

MAJOR DICK SMITH RE-SELLERS

These re-sellers stock a large range of our products. However we cannot guarantee they will have all items in stock, or at the prices we advertise

ATHERTON, QLD: Jue Sue's Radio Service
55 Main Street Phone 911 208

BENDIGO, VIC: Sumner Electronics
95 Mitchell Street Phone 431 977

BALLINA, NSW: A. Cummings & Co.
91-93 River Street. Phone 862 285

BLACKHEATH, NSW: Goodwin Electronics
123 Station Street. Phone 878 379

BROKEN HILL, NSW: Crystal TV Rentals
66 Crystal Street, Phone 6897

CAIRNS, QLD: Thompson Instrument
79-81 McLeod Street. Phone 512 404

COFFS HARBOUR, NSW: Coffs Harbour Elect
3 Coffs Harbour Plaza, Park Ave. Phone 525 684

DARWIN, NT: Kent Electronics
42 Stuart Highway. Phone 814 749

DUBBO, NSW: Dubbo Electronic Services
157 Brisbane Street. Phone 829 355

EAST MAITLAND, NSW: East Maitland Elect
Cnr Lawes & High Streets. Phone 337 327

GERALDTON, WA: KB Electronics & Marine
361 Main Terrace. Phone 212 176

GOSFORD, NSW: Tomorrow's Electronics
68 William Street. Phone 247 246

HOBART, TAS: Aero Electronics
123a Bathurst Street, Phone 348 232

KINGSTON, TAS: Kingston Electronics
Channel Court. Phone 296 802

LAUNCESTON, TAS: Advanced Electronics
5a The Quadrant. Phone 317 075

LISMORE, NSW: Decro Electric
Magellan Street & Bruxner Hwy. Phone 214 137

MACKAY, QLD: Stevens Electronics
42 Victoria Street, Phone 511 723

MARYBOROUGH, QLD: Keller Electronics
218 Adelaide Street, Phone 214 559

MORUYA, NSW: Coastal Electronics
43 Vulcan Street, 742 545

MT GAMBIER, SA: Hutchesson's Comm
5 Elizabeth Street, Phone 256 404

MUSWELLBROOK, NSW: Silicon Chip Elect
Suite 3, 98 Bridge Street. Phone 43 1096

NAMBOUR, QLD: Nambour Electronic Shop
Shop 4, Lowen House, Ann St. Phone 411 604

NEWCASTLE, NSW: Elektron 2000
181 Wharf Road, Phone 262 644

ORANGE NSW: M&W Electronics
173 Summer Street, Phone 626 491

PENRITH, NSW: Acorn Electronics
Shop 12 541 High St (Phone not yet connected)

ROCKHAMPTON, QLD: Purely Electronics
15 East Street, Phone 21 058

SOUTHPORT, QLD: Amateur's Paradise
121 Nerang Street, Phone 322 644

TAMWORTH, NSW: Sound Components
78 Brisbane Street, Phone 661 363

TOOWOOMBA, QLD: Hunts Electronics
18 Neil Street Phone 329 677

TOWNSVILLE, QLD: Tropical TV
49 Fulham Road, Vincent Village. Phone 791 421

TRARALGON, VIC: Power'n'Sound
147 Argyle Street Phone 743 638

WAGGA, NSW: Wagga Wholesale Elect
82 Forsyth Street

WODONGA, VIC: A & M Electronics
78a High Street, Phone 244 588

WHYALLA, SA: Mellor Enterprises
Sop 2. Forsythe Street. Phone 454 764

Dear Customer:

Quite often, the products we advertise are so popular they run out within a few days. Or, unforseen circumstances might hold up goods so that advertised lines are not in the store by the time the advert appears. Please don't blame the store manager or staff, they cannot solve a dock strike on the other side of the world, or even locate a shipment that has gone astray. What we are trying to say is that, if you are about to drive across town to pick up a particular line at a Dick Smith Store, why not give the store a ring first (addresses/phone numbers below) . . . just in case! Thanks

Dick Smith & Staff.

DSE A077RB

DICK SMITH Electronics

MAIL ORDER CENTRE: P.O. Box 321 North Ryde, NSW 2113. Ph. (02) 888 3200

NSW: 145 Parramatta Rd **Auburn** 648 0558 613 Princes Hwy **Blakehurst** 546 7744; 818 George St **Broadway** 211 3777; 531 Pittwater Rd **Brookvale** 93 0441, 147 Hume Hwy **Chullora** 642 8922; 162 Pacific Hwy **Gore Hill** 439 5311, 30 Grose St **Parramatta** 683 1133; 125 York St **Sydney** 290 3377; 173 Maitland Rd **Tighes Hill** 61 1896; 263 Keira St **Wollongong** 28 3800

ACT: 96 Gladstone St **Fyshwick** 80 4944 **QLD:** 166 Logan Rd **Buranda** 391 6233, 842 Gympie Rd **Chermside** 59 6255 **SA:** 60 Wright St **Adelaide** 212 1962 **VIC:** 399 Lonsdale St **Melbourne** 67 9834; 656 Bridge Rd **Richmond** 428 1614, Cnr Dandenong & Springvale Rds **Springvale** 547 0522 260 Sydney Rd **Coburg** 383 4455 **WA:** Cnr Wharf St & Albany Hwy **Cannington** 451 8666, 414 William St **Perth** 328 69 44

Order Value	Charges
$5-$9.99	$1.20
$10-$24.99	$2.20
$25-$49.99	$3.30
$50-$99.99	$4.40
$100 or more	$6.00

These charges for goods sent by Post in Australia only — Not airmail, overseas or road freight

ROD IRVING ELECTRONICS
425 HIGH STREET, NORTHCOTE 3070. MELBOURNE. PH (03) 489-8131
KITS
Please phone or write for full list of kits available
THIS MONTHS KITS
ALL KITS 5% OFF THIS MONTH ONLY
ELECTRONIC STETHOSCOPE ETI 332
$34.00
ETI-158 LOW OHMS METER
Resistance ranges you won't find on your multimeter P.O.A.
ETI-596 AUDIO NOISE GEN.
For testing or setting up audio equipment, make sound effects, etc. P.O.A.
NOW A $99 Computer!
Plugs into any TV!
ETI 660
No one would have believed it a few years ago. Features include: colour capability, operates from optional 9V plugpack, 1K memory expandable to 3K on-board, single board construction, cassette interface, audio output (play tunes), simple to program (uses Chip-8). Expansion projects coming up include: ASCII keyboard, light pen, games software etc. (So we are told).
Starter Kit, (1K RAM, B&W video) $99.00
9V, 200mA plugback to suit $6.50
Colour video option $8.00
RAM EXPANSION (add to PCB) $16.00
As with all new kits, please phone first to check stocks. We expect the kit to be in stock some time in Oct. 1981.
EA DIGITAL STORAGE CRO KIT
$78
ETI 256 HUMIDITY METER
$19.50
ETI330 CAR ALARM
$32.00
ETI 329 Expanded Scale Vehicle Ammeter
$17.00
ETI 458 LED LEVEL METER
$27.50
ETI 572 Digital PH Meter
$97.50
ETI 567 Core-Balance Relay
$42.00
UNIVERSAL RELAY BOARD ETI 257
$12.50
ETI 258 MINI DRILL CONTROL
ROD IRVING ELECTRONICS
425 HIGH STREET, NORTHCOTE 3070. MELBOURNE. PH (03) 489-8131
ROD IRVING ELECTRONICS
425 HIGH STREET, NORTHCOTE 3070. MELBOURNE. PH (03) 489-8131
ETI 475 AM Tuner
Case slightly different from one shown.
$89.00
S100 Prom Board
ETI 682
KITS $115.00
PCB $69.00
ETI 476 Series 3000
$84.00
ETI 568 Light & Sound Flash Kit
$25.00
ANALOGUE & DIGITAL STORAGE CRO KIT
$169
Series 5000 Mosfet $275.00
Series 5000 Preamp $235.00
ETI 477 Series 5000 Mosfet Power Amp
All parts individually available
$58.00
COME IN AND HEAR THE SOUND
KITS
Playmaster Graphic Analyser kit $99 50
EA 79SF9 Sound Flash Trigger $15 00
ETI 585R Ultra Sonic RX $15 95
ETI 585T Ultra Sonic TX $8 95
ETI 576 Electromyogram kit $89 00
ETI 147 Oct 80 Electronic Load kit parts $75 00
ETI 327 Turn Hazard Unit kit parts $22 00
EA Car Battery Voltage Monitor Oct EA kit parts $6 50
EA Bipolar Train Controller Nov 80 kit parts $26 00
EA Digital Storage CRO Adaptor Nov 80 kit parts $78 00
EA Light Beam Relay Nov 80 kit of parts $13 00
EA RS232 Printer Interface Nov 80 kit parts $15 00
EA Digital Engine Analyser Oct 80/80TM8a 10
Kit parts inc. front panel $49.50
ETI 729 UHF TV Masthead
$34.00
ETI1501 Negative Ion Generator
$39.00
Bankcard Mail Orders Welcome
Please debit my Bankcard
Bankcard No ....
Expiry Date..........................
Name..........................
Signature .... ETI 2/11/81
TO ORDER: Heavy items sent Comet Freight on. Mail Order phone 481-1436. Wholesale Customers phone: RITRONICS WHOLESALE 489-7099.
Mail Orders to P.O. 235 Northcote 3070. Minimum P&P $2. Add extra for heavy items, registration and certified mail.
Prices. spec. subject to change without notice.

A learners' microcomputer

With this installment the construction of the project is completed in stages, taking you right through to full colour operation and full on-board memory. As before, the project can be checked at each stage.

Design: **Hugh Anderson**
Development: **Graeme Teesdale**

Part 4

HAVING got the power supply running and checked that all is well with the board so far, you are now ready to assemble the unit for monochrome operation with the minimum amount of memory (1K).

First of all, remove the 8 Vac input power lead that you temporarily attached to test the first stage of construction. Sort out and solder in place the following resistors, as shown in overlay drawing 3:

R1	220R
R2	120k
R3	47k
R7	3k3
R10	1k2
R11	10k
R20,21,22	390R
R23	15k
R24	1k2
R25	8k2
R26	180R
R27	120k
R28	22k
R30	120k
R31	1M
R32	22k
R33	1M
R34	180k

Note that some of the resistor leads have to be soldered both sides of the board, so inspect each resistor position as you proceed and make sure you solder each lead appropriately. The easiest way to accomplish the task is to insert the resistors one at a time, solder each lead and then cut off the excess lead. This way you're less likely to miss soldering the occasional pad and lead.

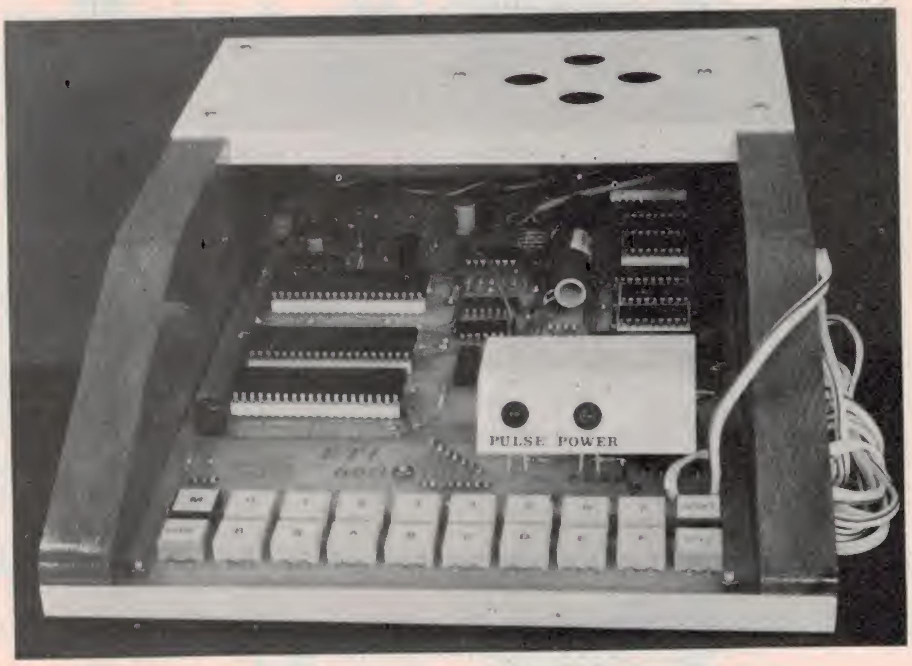
Next, tackle the remaining capacitors. Sort them out, identify where they go and solder them in place one by one, cutting the leads as you go. Refer to overlay drawing 3, also. Here they are:

C3	100n greencap
C4	10n greencap or ceramic
C5	3-30p trimmer
C7	470p ceramic
C8	100n greencap

Note that the trimmer, C5, may come in a variety of packages. Some are quite small and only have two pins. It doesn't matter which way around they go but note that there are only two 'correct' pads. Other types (particularly the Philips and Stetna types) have three pins and may be 7 or 8 mm in diameter. They will only fit on the board one way. There are three pads, so inspect how it goes in before you mount it on the board. The trimmer is located between IC1 and IC2. We should mention that the trimmer value and range are not too critical. A 5-40p or 8-60p may equally well be used.

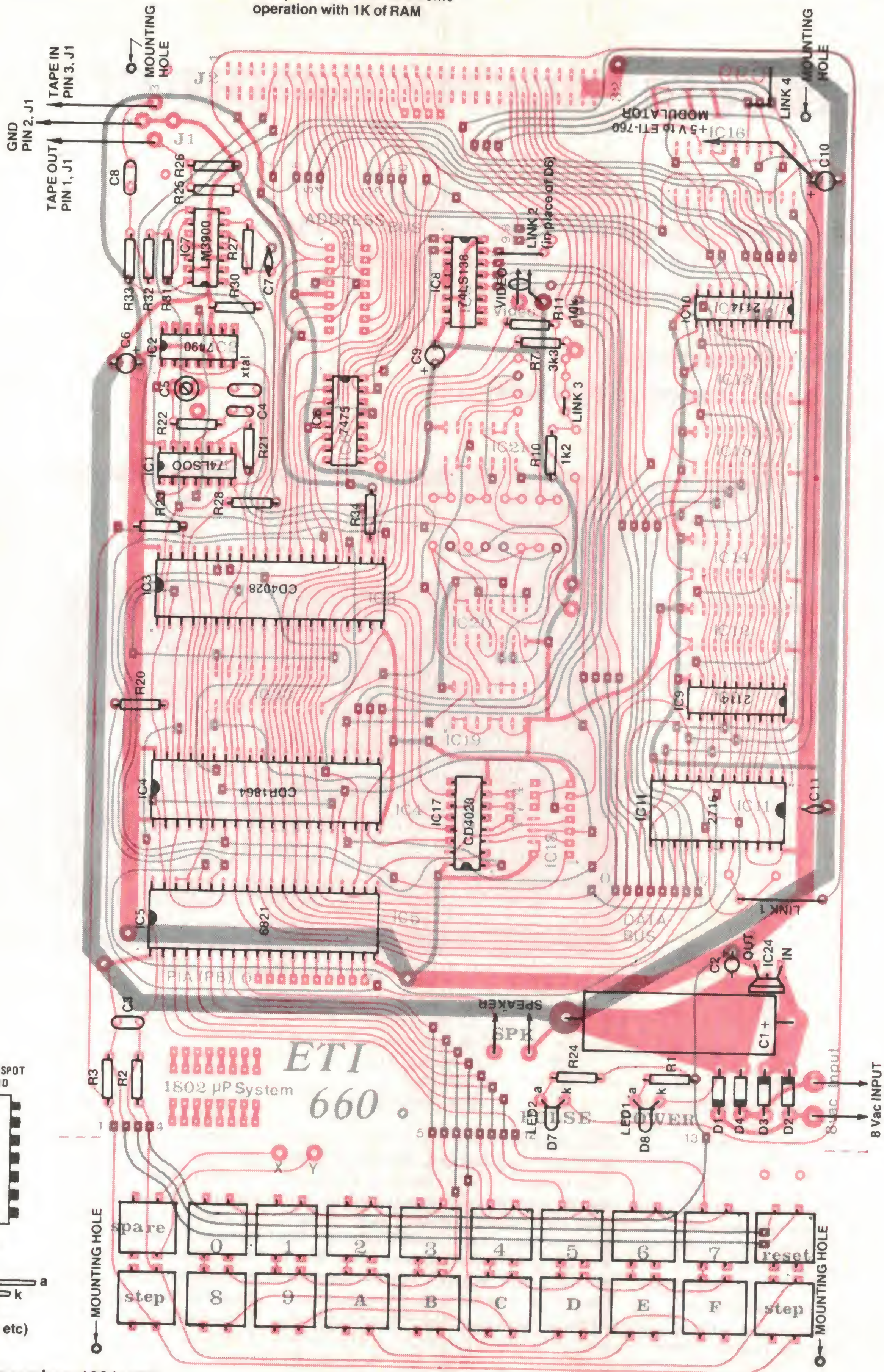
Capacitor C7 has one lead soldered on both sides of the board, note.

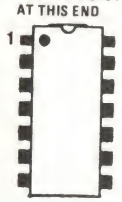
Solder the 8.867238 MHz crystal in place next. It doesn't matter which way round it goes, but solder quickly and cleanly to avoid overheating the device as excessive heat may damage it. It should be mounted fairly close to the board, but make sure the base sits two or three millimetres above the top of the board to avoid the crystal's case shorting to adjacent tracks on the top of the board.



The completed project mounted in the simple case we made up for it.

OVERLAY DRAWING #3
Components for monochrome operation with 1K of RAM



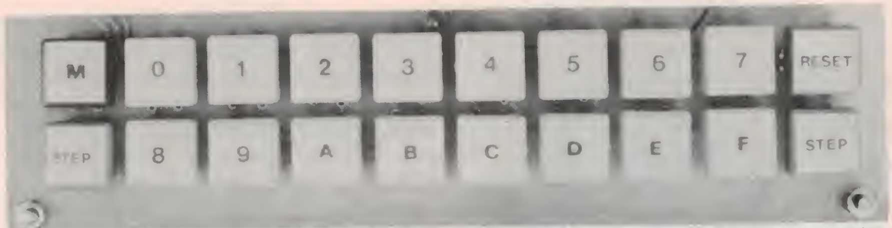


ICs

LEDs
(e.g: TIL220 etc)

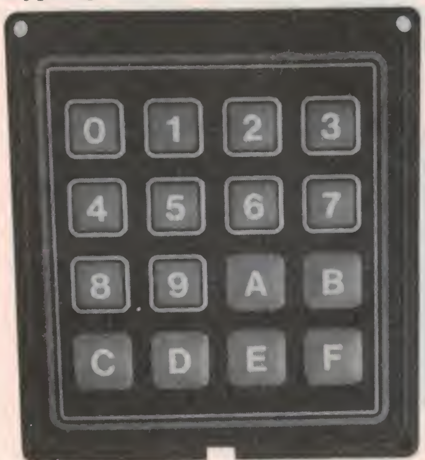
Keyboard

There are several options for the keyboard. As stated earlier in this series, you can opt for a standard hex keypad and add pushbuttons for the STEP and RESET buttons or you can use our design, which employs Fujitsu keyswitches (type FES-310) mounted on the main pc board in two rows.

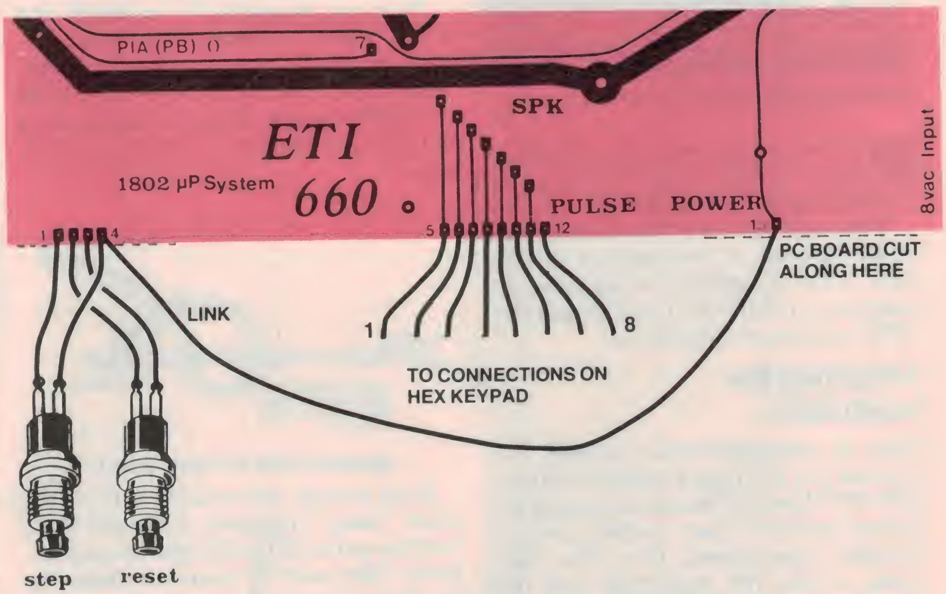


The FES-310 keyswitches we used have Scotchcal labels stuck on them to indicate which key is which.

If you are using a standard hex keypad plus pushbuttons for the STEP



A hex keypad may be used instead of our keyboard. These will have eight pins on the rear marked '1' to '8', which are connected as shown in the accompanying drawing.



HOW TO CONNECT A STANDARD HEX KEYPAD AND 'STEP' & 'RESET' PUSHBUTTONS

and RESET then the pc board may be foreshortened if you wish. On the underside of the board you will notice a short, dashed line adjacent to the 8 Vac input pads. On the opposite edge of the board is another dashed line. A straight cut between these two dashed lines will part our keyboard section from the main board. Your hex keypad then connects directly to the row of pads in the middle of the board — one outer pad is marked '5' and the other '12' on the top of the board.

The RESET pushbutton connects to the two pads marked '1' and '4' on the top of the board, while the STEP pushbutton connects to the two pads between these. Link the pad marked '4' to the pad marked '13' with a length of insulated hookup wire.

If you have elected to go with our design of keyboard then the FES-310 keyswitches can be inserted in the board and soldered in place. Note that you can leave out the SPARE key and one of the STEP keys if you wish, in which case only 18 keys are required.

The Fujitsu keyswitches have no markings on them. We made up some small Scotchcal labels and stuck them on the keys after they were soldered in the board.

Links

There are four links to install. One is adjacent to IC11 (LINK 1); another is adjacent to IC8 (LINK 2), right near the video output pads. LINK 3 is between R7 and R10 and LINK 4 is adjacent to the position of IC16. With the latter, note there are three feedthrough links between IC16 and the adjacent mounting hole — join them together and bridge them to the 0 V track that runs nearby. You should be able to see this link clearly on overlay drawing 3. Use insuiated hookup wire for LINK 1, 22g tinned copper wire for the other three.

ICs

The non-socketed ICs may be assembled to the board next. These are:

IC1	74LS00
IC2	7490
IC6	7475
IC7	LM3900
IC8	74LS138
IC17	4028

Watch their orientation. This should be clear from overlay drawing 3 but don't forget that the top side of the board has a small spot adjacent to pin 1 of each IC. No excuses if you get one in back to front!

Take care that you don't bend any pins under the IC package and that you solder all pins. Watch for solder 'bridges', as we've warned you earlier. Apart from that, no special care need be taken with these ICs.

If you're *not* using sockets, solder ICs 3, 4, 5, 9, 10 and 17 in place too. You should use a socket for IC11, as this IC may be changed or reprogrammed later.

Now you can solder LED2 (D7) in place. Mount it so that it stands the same height as does LED1.

Take a pair of long-nose pliers and grip one of the LEDs by the leads about 5 or 6 mm back from the bottom of the head. Bend it away from C1 so that the head faces the keyswitches at about 60° to the vertical. Do the same with the other LED.

At this stage, if you don't have, or have not made, the heatsink bracket for IC24 — do it now. This is a small piece of aluminium, 60 mm square, drilled and bent up as per the drawings available from us, or in your kit. There is a hole near one corner, on the part bent down at 90°, to which the metal flange of IC24 is bolted, and two holes on the angled section in which LED-mounting clips are inserted to accommodate the two LEDs. It is easiest to assemble if you carefully insert the two LEDs first, and then bolt it to the tab on IC24. Note that IC24 bolts on the *outside*. This simple little assembly is visible in the photo- ▶

How the heatsink bracket for IC24 is mounted.

graphs. We attached Scotchcal labels to the front of this plate showing the 'PULSE' and 'POWER' LEDs.

Temporarily wire the speaker up with about 200 mm of twisted-pair hookup wire. The two speaker connections are near the −ve end of C1 and are marked 'SPK' on the top of the board.

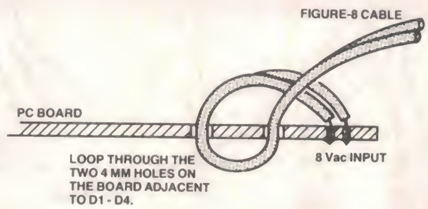
Attaching the modulator

This is straightforward enough. We assume you've already constructed your ETI-760 Video RF Modulator as per the project article in last month's issue. A shielded lead comes from the video input of the 760 modulator and this should be attached to the pads on the board adjacent to IC8 marked 'Video'. Cut the lead to a length of about 250 - 300 mm — longer if you like, but not any shorter. The shield braid need only be soldered on the top side of the board; the inner conductor solders to the adjacent pad on the underside of the board.

The power supply connection to the modulator comes next. Cut this about 50 or 100 mm longer than the video lead. It solders to the positive (+) lead of capacitor C10, on the top of the board. You can locate this capacitor on overlay drawing 3; it's adjacent to the position of IC16 (not in place at this stage), near one of the mounting holes.

Now you're almost ready for *the big switch on!* But before you do, run over everything you've done once more and make sure there are no tracks bridged, leads left unsoldered or components missing. Check your board against overlay drawing 3. If all is well, you can plug in IC3 (1802), IC4 (1864), IC5 (6821), IC9 and IC10 (2114) and IC11 (2716 or 2516) — we're assuming you've used IC sockets for these chips as recommended and that you have your EPROM (IC11) already programmed. Make sure you plug these ICs in the right way round and that no pins get folded under the package. Handle the packages by the ends using only your thumb and forefinger, taking care not to touch the pins, as these are CMOS devices which are susceptible to damage from static created by clothing, carpets, etc. Whilst they are generally quite robust, a little care prevents later disappointment, frustration and harsh words unfairly voiced about the origins of certain component suppliers.

You can temporarily re-attach the 8 Vac input lead from your plugpack. Connect the RF output of the 760 modulator to the antenna input of your TV set — B&W or colour, but you're only going to get monochrome video. Now power up.



SECURING THE AC INPUT CABLE

If all is well, the speaker will emit a short "beep", the power LED will light and the pulse LED will light up momentarily. Set your TV channel selector to channel 1 (or switch across channels 1, 2 and 3 until you get a picture). Adjust the trimmer in the 760 modulator for a good signal. You may need to adjust the controls on the TV to get a sensible picture on the screen. When it 'locks in' you should see something like this:

Press RESET if you have a stable picture but it doesn't make sense, and then you should get something like the above. Press RESET (again, or for the first time) and you will see the screen go blank momentarily, the speaker will emit a short 'beep', the pulse LED will light briefly and the screen will come back with the same picture. The random pattern you see in the top portion of the picture is just what happens to be in the video display memory. The bar at the bottom contains a four-digit number which is a little to the left of centre. This is a hex representation of a memory location.

Now that it makes sense, try this:

press 'RESET'

press '8'

This will get rid of the random pattern above the solid bar. If it leaves a few bits above the bar press RESET again or turn the power off briefly, then on again and repeat 'RESET' '8'.

Now,

press '0'

press '0480'

press 'STEP'

The screen will now show '0480 00' in the bar at the bottom of the screen. Now press 'FF'.

The screen will now show a short horizontal line at the top left hand corner of the screen and the bar at the bottom will show '0480 FF'.

You will notice that when you press a key the speaker will emit a beep and the pulse LED will flash — but not when you press the STEP key. The keys at the 0, 1, 2, 3 end of the keyboard are accompanied by a short 'pip' when pressed, those at the D, E, F end of the board by a longer 'beep'. The beep that signifies you've pressed the RESET key is much the same length as the one that sounds when you press F.

Now try this:

press 'RESET'
press '0'
press '0490'
press 'STEP'
press 'FF'

The screen will show '=' at the top left-hand corner and '0490 FF' in the bar at the bottom.

What you are doing is looking at the video display memory and entering data into it which are then displayed.

Now try this one: turn the power off briefly, then on again. This will bring up the original pattern with random dots and the bar at the bottom showing a strange four-digit number

press 'RESET'
press '0'
press '0600'
press 'STEP'
press '00'
press 'STEP'
press 'FC'
press 'STEP'
press 'RESET'
press '6'

The screen will now go blank!

Press RESET to return the display. Now you're ready to put the thing in its box, or whatever you're going to house it in, if you're not going any further with construction (be assured, this will only be temporary because once you've been bitten by the bug you'll always want to do more!). Next thing is to try your hand at programming — see 'Programming in CHIP-8 — a crash course' elsewhere in this issue.

LETTERS AND NUMBERS

The letters and numerals that make up the hexadecimal indications displayed on the TV screen from the ETI-660 microcomputer are fairly basic in construction, and it's handy to get to know what you're looking at to avoid confusion. They are of seven-segment construction, so the numerals 0 to 9 will look familiar as they're much like those on a seven-segment LED display — the '6' has a tail across the top and the '9' has a tail across the bottom. Of the letters A to F, 'B' and 'D' appear sort of lower case. Don't confuse 'b' for a '6'. The accompanying four pictures show the complete set in order from 0 to F.

Adding colour

Having got your 660 up and running in monochrome you can add the components necessary for colour operation. Firstly, you're going to have to remove all those external connections — the 8 Vac input lead, the speaker leads and the connections to the 760 modulator (video and +5 V supply). Also, remove LINK 2 between R7 and R10 and LINK 4 adjacent to IC16.

You will need an additional 16 resistors, three of which substitute for resistors originally used for monochrome operation. Those marked on the parts list with an asterisk (*) are only used for colour operation, those marked with a double asterisk (**) change when adding the colour option. Sort out the following resistors and solder them in place according to overlay number 4:

R4	4k7
R5	1k
R6	4k7
R8	680R
R9	68R
R12	5k6
R13	1k2
R14	1k5
R15	2k7
R16, R17	2k2
R18	1k2
R19	4k7

Change:

R7 to 2k2
R10 to 470R
R11 to 5k6

Note that R5 has one lead soldered on both sides of the board.

Next, solder the 400 ns delay line to the board. This device will have three leads. One is an 'earth' lead. This solders to a section of the 0 V track which runs on the topside of the board from the video output connection to near IC20. The pad is located adjacent to R8. Location and orientation of the delay line on the board should be clear from overlay drawing 4.

If you have been unable to obtain a delay line then the 660 may be operated in the colour mode without it with meaningful, if not acceptable, results. Simply link the two pads that connect the 'input' and 'output' ends of the delay line — the pad that connects to the junction of R4, R5, R6, and R7 and one end of R8. Use a length of insulated hookup wire to do this. You can replace this with the delay line at a later date.

Last of all, the ICs may be assembled to the board. Note that we used a socket with IC16. Just as an aside, this IC may be any of a number of equivalent types; the 2101 is now superseded but it may be replaced directly by either a 5101 or a CDP 1822. We did not use sockets on the other ICs used in the colour encoder portion of the circuitry. Sort out and solder in place these ICs, then:

IC18	74LS00
IC19	74LS86
IC20	74LS00
IC21	4066

Take care that you orient each IC correctly as you insert it. IC16 and IC21 are CMOS types and you should only handle the packages by their ends, using your thumb and forefinger, to insert them. During soldering, take care once again not to get solder bridges between tracks and that you don't have any dry joints.

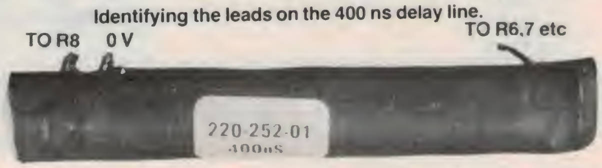
Once again, having completed this phase of construction, *check everything you've done*, especially IC orientation.

Get ready!

Now you can attach the 760 modulator, the loudspeaker and the 8 Vac input lead again. Connect the RF output of your 760 modulator to the antenna input of your colour TV set. Now power up.

As before, if all is well the speaker will emit a short "beep", the power LED ▶

Identifying the leads on the 400 ns delay line.



will light and the pulse LED will flash. Set your TV receiver to the appropriate channel and adjust the controls for a sensible picture. At this stage it may only be monochrome. Press RESET and you should get the random pattern on the screen with the bar at the bottom containing a strange four-digit number, as before. If you have fluked everything, the background colour will be blue and the pattern white. If not, adjust the crystal oscillator trimmer, C5, and you should be able to get the background colour to 'pop in'. Adjust the controls on the TV set to suit yourself. If no result, switch off and check your construction — particularly see that you have all the resistors for colour operation correctly placed and soldered.

Now you can go through the same checking procedure as for monochrome — this time the display will be in blue and white!

Colour check

Here is a simple series of tests to demonstrate/check-out the colour operation. Turn off the power briefly, then on again. You should get the random dot display (in white) with the bar at the bottom showing '1bEF' on a blue background. Press RESET if you don't and it should appear. Then,

press '0'
'07B0'
'STEP'
'E9'
'STEP'
'61'
'STEP'
'D4'
'STEP'
'RESET'
'0'
'0600'
'STEP'
'07'
'STEP'
'B0'
'STEP'
'07'
'STEP'
'B0'
'STEP'
'07'
'STEP'
'B0'
'STEP'
'07'
'STEP'
'B0'
'STEP'
'16'
'STEP'

At this point the four-digit number in the bar at the bottom of the screen should show '0609'. If it doesn't you're going to have to press RESET and start all over again. If it shows '0609' then proceed with:

'02'
'RESET'
'8'

The screen will come to life with a 'licorice allsorts' pattern with a series of stripes at the top and bottom of the screen and a broad band in the centre stepping rapidly through BLUE-BLACK-GREEN-RED continuously while the stripes at the top and bottom seem to 'roll down' the screen.

You can try a variation on that by altering the program, as follows:

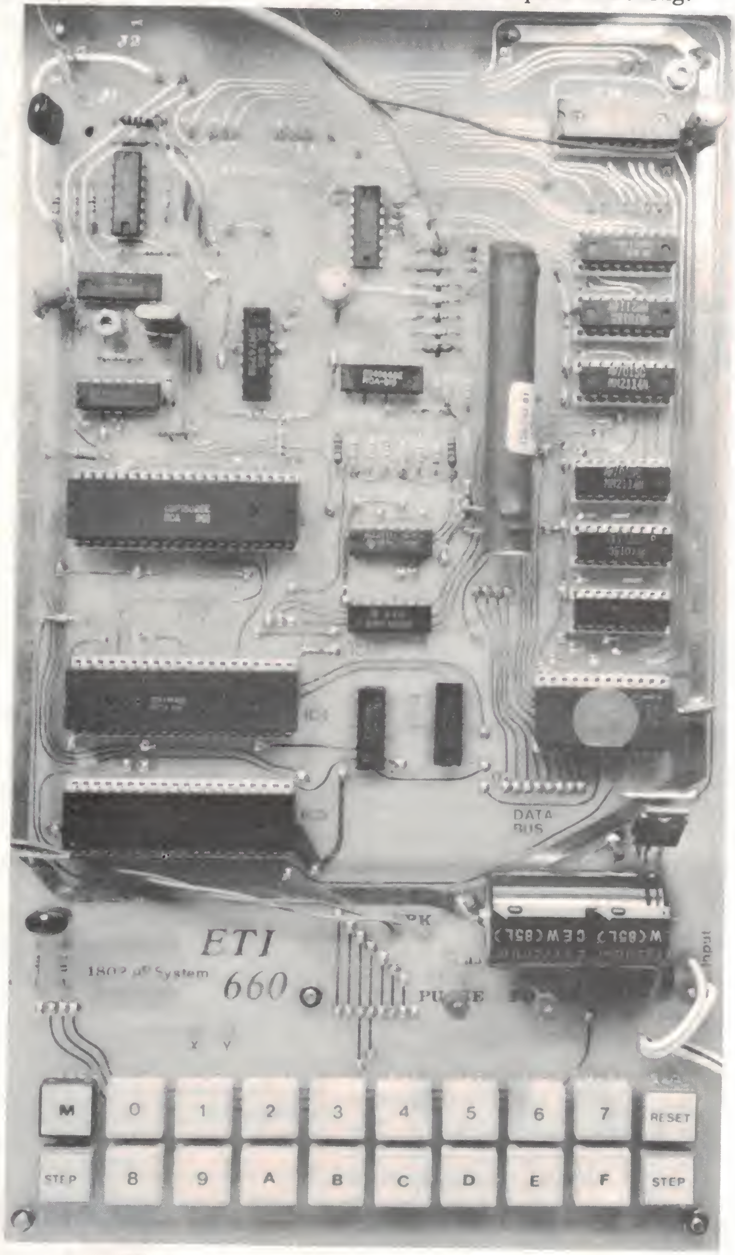
press 'RESET'
(this will stop the mesmeric action on-screen)
'0'
'0609'
'04'
'RESET'
'8'

The licorice allsorts pattern will appear again, only this time BLUE and GREEN will stay on-screen longer than RED and BLACK and the stepping through of the colours becomes a little 'jerky'.

Now try this:

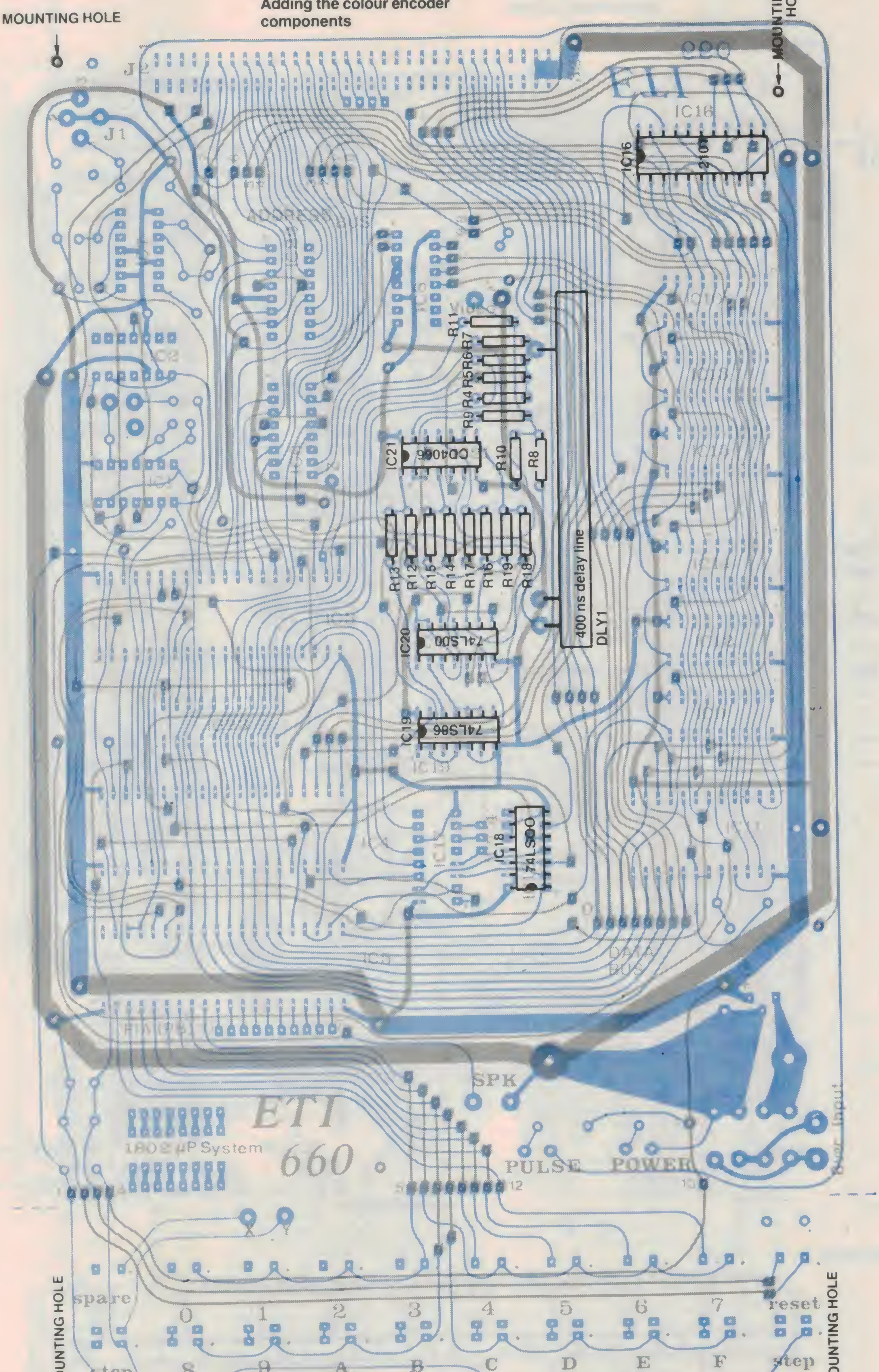
press 'RESET'
'0'
'0609'
'06'
'RESET'
'8'

The effect is quite sickening! ▶

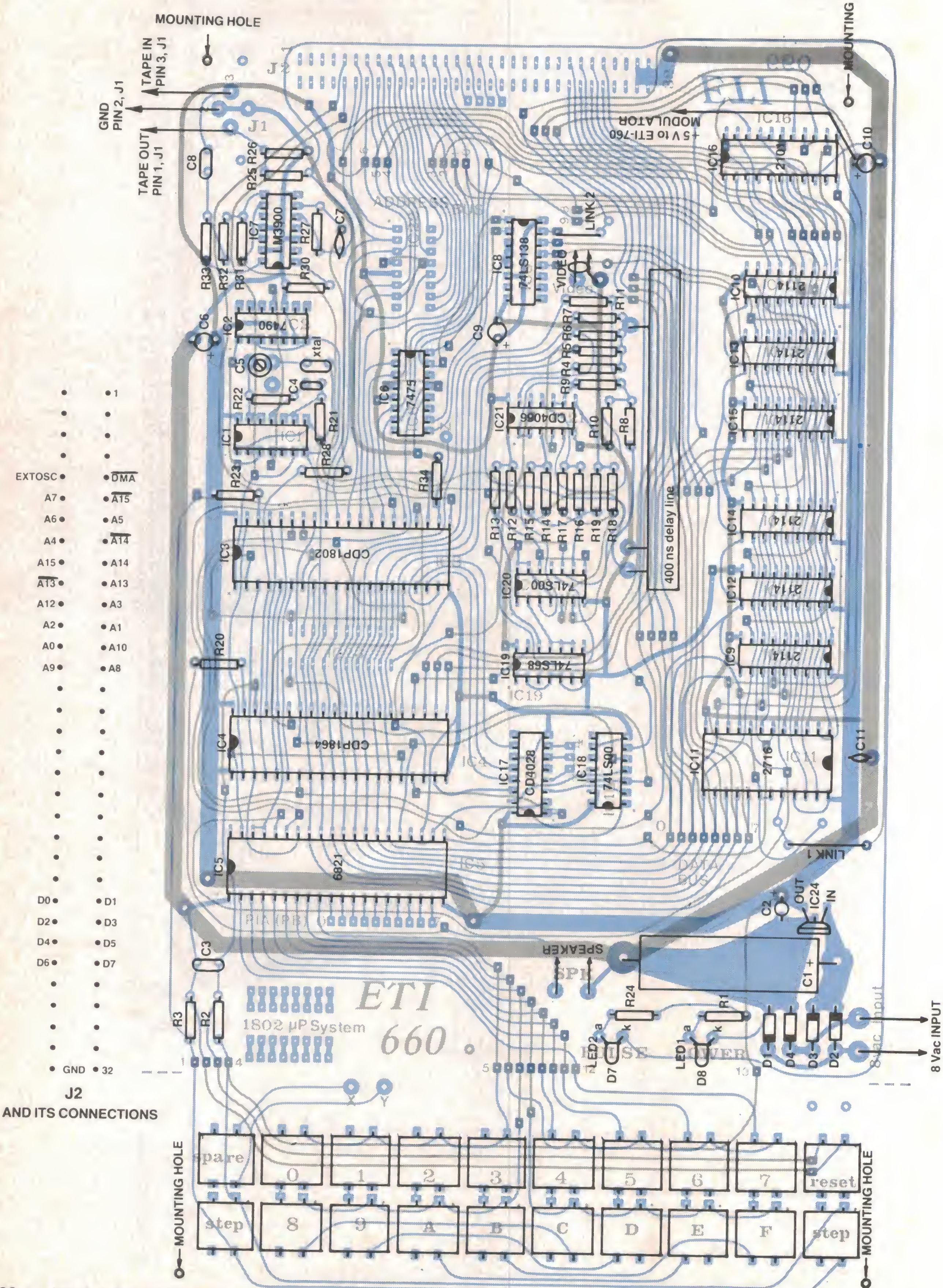


The completed board with colour and 3K RAM.

OVERLAY DRAWING #4
Adding the colour encoder components



OVERLAY DRAWING #5
Complete project with colour and 3K of RAM



J2
AND ITS CONNECTIONS

THE CHIP-8 MONITOR PROGRAM

So that your ETI-660 microcomputer will behave in a predictable, logical way when you press a simple sequence of keys on the keyboard, a program is permanently stored in a Programmable Read-Only Memory, or PROM — which is IC11 on the pc board, a 2716 or 2516. You cannot alter any part of the program in this memory by any operation of your ETI-660.

The information, or program, stored in IC11 is interpreted by the 1802 microprocessor as a series of 'instructions'. The program causes the 1802 (IC3) to activate IC5, the MM6821 Peripheral interface Adaptor (PIA), which 'reads' instructions entered via the keyboard, for example. It also causes the 1802 to activate the CDP1864, which provides video and audio outputs. In essence, it controls the basic functional operation of the 1802 microprocessor so that it does a specific task in a specific way in response to a simple instruction from the keyboard.

Following is a listing, in hexadecimal code, of the monitor program residing in the PROM, IC11. Whilst the listing shown commences at location 3000, running to 33FF, it actually has to reside in the PROM from location 0000 to 03FF. Kit and component suppliers may supply the PROM already programmed. If you're obtaining your components individually then you'll need to find a firm that will program your PROM for you.

Whilst the PROM has a capacity of 2Kbytes, this program only occupies the 'lower' 1K. The 'upper' 1K is 'empty' and may be programmed with some other set of instructions at a later date.

```
. :  3000 F8 04 B2 B6 F6 B4 F6 B1
. :  3008 F6 B5 A4 F8 38 A1 A2 F6
. :  3010 A5 F8 0F 52 E2 62 F8 20
. :  3018 52 62 A8 D4 20 4E F0 0A
. :  3020 00 FC B0 3A 20 4E F0 0A
. :  3028 00 88 78 10 00 DD 20 62
. :  3030 F0 0A 10 4A 01 BC 20 6E
. :  3038 10 2A 10 24 01 8B 01 60
. :  3040 02 40 00 E0 00 F8 26 00
. :  3048 00 00 00 72 10 36 02 EB
. :  3050 00 F8 68 10 69 2A 00 BF
. :  3058 20 62 78 04 00 BD 20 62
. :  3060 00 EE F1 29 D8 95 78 04
. :  3068 F0 29 D8 95 00 EE 02 F2
. :  3070 10 52 0B FE FE FE FE 5B
. :  3078 EB 8D F4 5B D4 FF EF D3
. :  3080 8B FE AB 9B 7E BB 30 7E
. :  3088 96 BF AF F8 80 BE AE F8
. :  3090 24 A5 DE DE DE DE 5F 1F
. :  3098 8B 5F 8D F4 5F D4 42 30
. :  30A0 A7 42 32 A6 15 15 D4 32
. :  30A8 A4 D4 22 F8 03 BC F8 CB
. :  30B0 AC 06 FA 0F FC 01 52 DC
. :  30B8 E2 F5 52 45 A3 8B 38 9B
. :  30C0 22 52 96 BE F8 70 AE 42
. :  30C8 5E 1E F6 F6 F6 F6 5E D4
. :  30D0 1B 4B 32 DC FF 31 32 D0
. :  30D8 FF 01 3A D1 D4 0B 30 C0
. :  30E0 96 BF F8 80 AF 93 5F 1F
. :  30E8 9F FF 06 3A E5 D4 42 B5
. :  30F0 42 A5 D4 45 E6 F4 56 D4
. :  30F8 22 69 12 D4 22 6C 12 D4
. :  3100 18 1D 28 30 1A 26 2A 1C
. :  3108 2C 2E 16 14 12 20 24 10
. :  3110 E0 80 E0 80 80 80 E0 A0
. :  3118 E0 A0 A0 A0 E0 20 20 20
. :  3120 20 20 E0 A0 E0 80 E0 80
. :  3128 E0 20 E0 80 E0 A0 E0 A0
. :  3130 E0 20 E0 20 E0 7A 42 70
. :  3138 22 78 22 52 C4 19 F8 80
. :  3140 A0 96 B0 E2 E2 80 E2 E2
. :  3148 20 A0 E2 20 A0 E2 20 A0
. :  3150 3C 45 98 32 59 A0 20 80
. :  3158 B8 88 32 35 7B 28 30 36
. :  3160 F8 E2 A1 F8 D4 D1 81 BD
. :  3168 D7 3B 66 9D 3A 68 D7 33
. :  3170 6E 93 BD AD D7 9D 7E BD
. :  3178 3B 74 D7 8D F6 33 FE 9D
. :  3180 5E 8E D1 1E 2C 9C 3A 6E
. :  3188 C0 00 00 F8 E2 A1 F8 BF
. :  3190 D1 F8 E0 BD FF 00 D7 9D
. :  3198 3A 94 8E D1 7B 4E BB FC
. :  31A0 00 F8 09 AB AD D7 2B 8B
. :  31A8 32 AF 9B FE BB 30 A5 8D
. :  31B0 F6 D7 2C 9C 3A 9A D7 D7
. :  31B8 D7 30 88 FF 1B D4 D3 7B
. :  31C0 F8 39 3B C7 F8 0D 1D 52
. :  31C8 FF 01 33 C8 39 BE 7A 02
. :  31D0 30 C8 1D D3 F8 17 35 D6
. :  31D8 35 D2 FF 01 33 D8 3D DE
. :  31E0 30 D3 A7 91 B7 96 BD 95
. :  31E8 AD 4D BE 4D AE 1D ED F5
. :  31F0 AC 2D 9E 75 FC 01 BC E2
. :  31F8 D3 22 52 64 30 F8 7B 00
. :  3200 96 B7 E2 94 BC 45 AF F6
. :  3208 F6 F6 F6 32 29 F9 30 AC
. :  3210 8F FA 0F F9 70 A6 05 F6
. :  3218 F6 F6 F6 F9 70 A7 4C B3
. :  3220 8C FC 0F AC 0C A3 D3 30
. :  3228 00 8F B3 45 30 25 45 56
. :  3230 D4 03 03 03 03 03 02 00
. :  3238 03 03 02 03 02 02 00 03
. :  3240 DB 7C 75 9E A8 B2 2E F3
. :  3248 81 AE 50 B6 55 60 AA 05
. :  3250 45 AA 86 BA D4 E9 99 F4
. :  3258 E6 F4 B9 56 45 F2 56 D4
. :  3260 06 BE FA 3F F6 F6 F6 22
. :  3268 52 07 FE FE FE F1 AC 96
. :  3270 7C 00 BC 8C FC 80 AC 9C
. :  3278 7C 00 BC 45 FA 0F AD A7
. :  3280 9C FF 06 32 DB F8 50 A6
. :  3288 F8 00 AF 87 32 E2 27 4A
. :  3290 BD 9E FA 07 AE 8E 32 A1
. :  3298 9D F6 BD 8F 76 AF 2E 30
. :  32A0 95 9D 56 16 8F 56 16 30
. :  32A8 88 EC EC F8 50 A6 F8 00
. :  32B0 A7 8D 32 DB 06 F2 2D 32
. :  32B8 BB 91 A7 46 F3 5C 02 FB
. :  32C0 07 32 CE 1C 06 F2 32 CA
. :  32C8 91 A7 06 F3 5C 2C 16 8C
. :  32D0 FC 08 AC 9C 7C 00 BC FF
. :  32D8 06 3A B1 F8 7F A6 87 56
. :  32E0 12 D4 8D A7 87 32 A9 2A
. :  32E8 27 30 E4 96 BF AF 4F BB
. :  32F0 0F AB F8 05 BF F8 C8 AF
. :  32F8 F8 FF 5F 1F 8F 3A F8 D4
. :  3300 22 06 52 64 D4 45 A3 98
. :  3308 56 D4 93 BC F8 CB AC DC
. :  3310 3A 0F DC 30 F7 06 B8 D4
. :  3318 06 A8 D4 64 0A 01 E6 8A
. :  3320 F4 AA 3B 28 9A FC 01 BA
. :  3328 D4 91 BA 06 FA 0F AA 0A
. :  3330 AA D4 FF E6 06 BF 93 BE
. :  3338 F8 1B AE 2A 1A F8 00 5A
. :  3340 0E F5 3B 4B 56 0A FC 01
. :  3348 5A 30 40 4E F6 3B 3C 9F
. :  3350 56 2A 2A D4 FF 22 86 52
. :  3358 F8 70 A7 07 5A 87 F3 17
. :  3360 1A 3A 5B 12 D4 22 86 52
. :  3368 F8 70 A7 0A 57 87 F3 17
. :  3370 1A 3A 6B 12 D4 15 85 22
. :  3378 73 95 52 25 45 A5 86 B5
. :  3380 D4 45 FA 0F 3A 89 07 56
. :  3388 D4 AF 22 F8 D3 73 8F F9
. :  3390 F0 52 E6 07 D2 56 F8 7F
. :  3398 A6 F8 00 7E 56 D4 45 E6
. :  33A0 F3 3A A7 3F A3 15 15 D4
. :  33A8 45 E6 F3 3A A5 D4 45 07
. :  33B0 30 A9 45 07 30 9E F8 70
. :  33B8 A7 E7 45 F4 A5 86 FA 0F
. :  33C0 3B C4 FC 01 B5 D4 2D 2D
. :  33C8 2D 8D D3 96 BF BE F8 4C
. :  33D0 AF F8 48 AE F8 10 AD F8
. :  33D8 F7 BD 5E EE 62 2E EF 6A
. :  33E0 FE 3B C9 FE 3B C8 FE 3B
. :  33E8 C7 FE 3B C6 2D 2D 2D 2D
. :  33F0 9D F6 BD 33 DA 30 C9 3F
. :  33F8 A3 32 12 A8 2D 8D 56 D4
```

NOTE:

There were several small errors in the Parts List published last month.

**R11 ... 10k (5k6 for colour)
R12 ... 5k6 *IC19 ... 74LS86

Note the changes for R11 and R12, IC19 is a 74LS86 (not a 74LS68) and a total of 20 (not 18) FES-310 pushbuttons are specified.

All OK?

If all is operating well at this stage, then you're ready to start learning to make use of your computer. Turn to 'Programming in CHIP-8 — a crash course' elsewhere in this issue.

More memory

So far we have only described construction with the minimum amount of memory (1K). There is provision for up to 3K of memory to be available on-board and adding it is very simple.

You can add more memory in stages, as your money permits, or you can take the memory up to 3K in one go. If you have used sockets as we recommended then all you need to do to add another 1K of memory is buy another two 2114 RAM ICs. These should be inserted in the positions shown for IC12 and IC13. Note that IC12 is adjacent to IC9 and IC13 is adjacent to IC10. Refer to overlay drawing 5, which shows the completed 660 with all current options on-board. To add the last 1K of memory, two more 2114 ICs are required and these go in the positions shown for IC14 and IC15 on overlay drawing 5.

If you are soldering these in place, once again, take care that you don't get any solder bridges between pins or dry joints, and take particular care with the orientation. *— continues page 43.* ▶

ACKNOWLEDGEMENTS

This project would not have come to fruition had it not been for the efforts of three New Zealanders. Jim Coyle of (at that time) Kit Parts N.Z. had a new kit in his inventory which he thought (a) should enjoy a wider currency and (b) could benefit from the 'ETI treatment'. We bought the idea(s). That original unit was known as the 'HUG 1802' — after the man who developed it for Kit Parts, Hugh Anderson, and the microprocessor employed — the 1802.

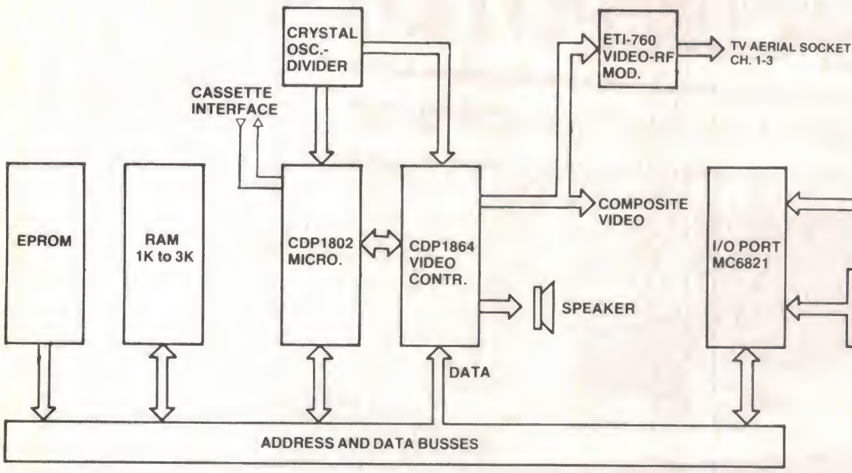
Hugh Anderson is New Zealand's answer to Leonardo da Vinci — electronically speaking. Like Leonardo, Hugh is more concerned with execution of a never-ending succession of brilliant ideas than the general dissemination of same. Jim Coyle was to Hugh what the Medicis were to Leonardo.

Between the time we arranged to give the project the 'ETI Treatment' and when we came to ponder just who was to undertake the exercise, one Graeme Teesdale — an electronics lecturer and hobbyist extraordinaire from Hamilton N.Z. — requested the opportunity to spend his 1981 sabbatical working at ETI. He said his forte was microprocessors and that it wouldn't cost us anything.

That clinched it!

During three months early in 1981 Graeme tackled the monumental task with gusto and this finely wrought machine is the result — after encountering a succession of difficulties which he managed to surmount. May the bags under his eyes grow ever less!

Roger Harrison
Editor ETI.



OVERALL BLOCK DIAGRAM

HOW IT WORKS — ETI 660

The accompanying block diagram shows the overall arrangement of this microcomputer. The 1802 (IC3) microprocessor performs tasks according to instructions from a program, entered by the user, under the control of a 'monitor' program resident in EPROM (IC11 — a 2516 or 2716). The user's program is stored during operation in Random Access Memory — RAM — on board (ICs 9 and 10 for 1K of memory, ICs 12 to 15 take it to a total of 3K). Programs are entered using a simple hexadecimal (base 16 number system) keyboard via a Peripheral Interface Adaptor — or PIA — IC5 (MC6821). This provides interfacing to the real world via input/output (I/O) 'ports' (control lines) enabling the user to get 'into' the computer to operate it and get signal 'out' of it to control peripheral equipment that may be attached (e.g: printer, sound synthesiser, etc).

To communicate to the user what's happening with the microprocessor a Video Controller chip (IC4, a CDP1864) generates the appropriate synchronisation and composite video signals, which can be connected directly to a video monitor or to a TV set via a Video RF Modulator (Project ETI-760, Oct. '81) to provide a video display. This chip also generates an audio output which drives a speaker, providing up to 256 programmable tones. Monochrome or colour video signals are obtained by combining the appropriate video controller outputs in suitable external circuitry.

To 'clock' the operation of the microprocessor and video controller a crystal oscillator and divider chain generates the appropriate frequencies from a single crystal of a suitable frequency (8.867238 MHz).

A cassette interface is simply provided direct from the microprocessor, the signals being suitably modified by two op-amps.

Power supply is straightforward. All the circuitry runs from a single 5 V rail derived from a bridge rectifier powered by an ac output plugpack.

Following is a general explanation of how the devices in each portion of the circuit carry out their functions.

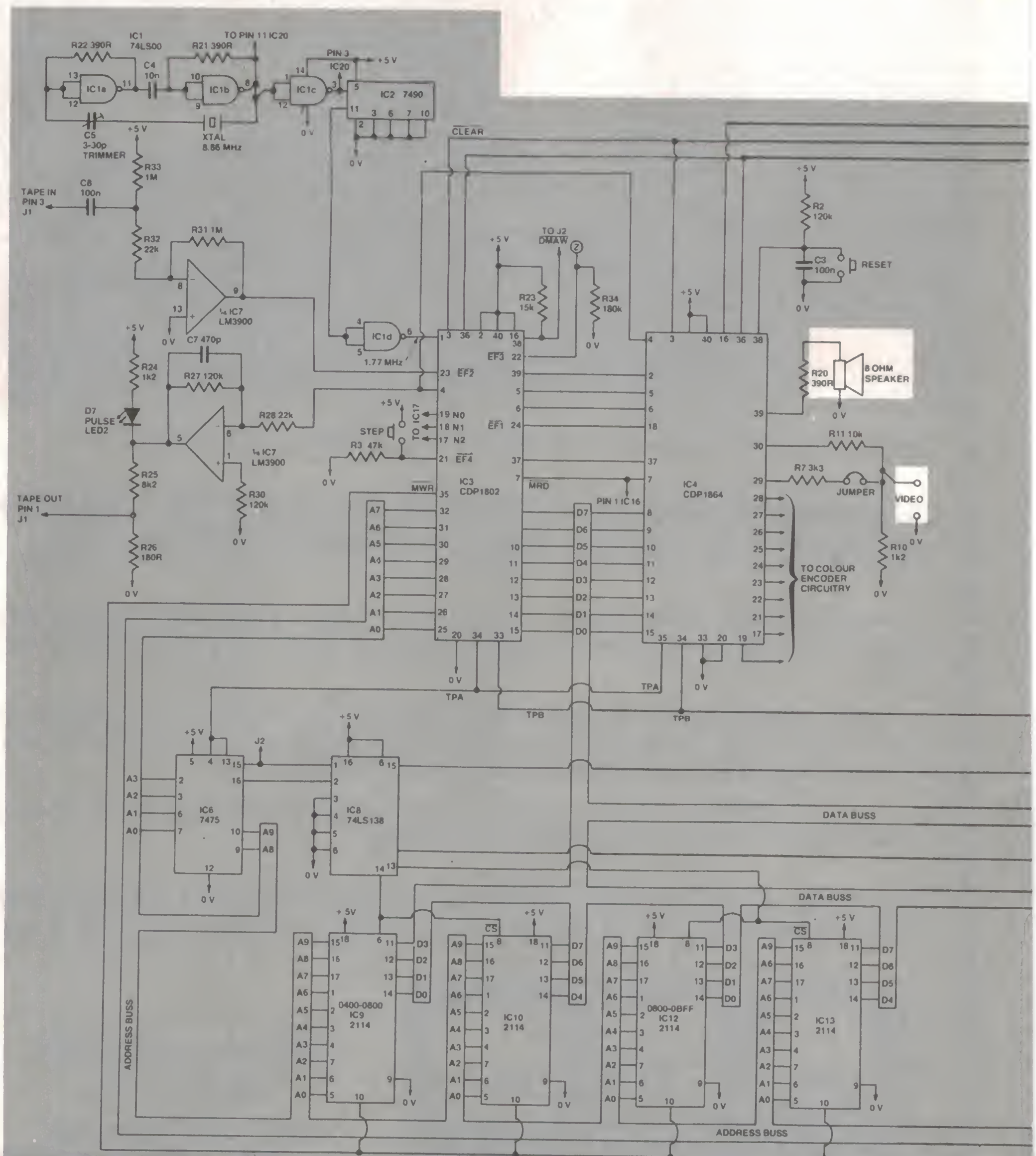
POWER SUPPLY

An 8 Vac/1 A output plugpack is used to power the project. Its output is recified by a diode bridge, D1-D4, C1 being the filter capacitor. The dc output is regulated to 5 V by a three-terminal regulator, IC24. Capacitor C2 is located physically as close as possible to IC24 and provides high frequency stability. For this reason it is a tantalum type. Capacitors C6, 9, 10 and 11 are supply rail bypasses located at strategic points on the tracks around the circuit board.

A 'power on' indicator is provided by D8 (LED1), a red LED which derives its bias current from the +5 V rail via R1.

CLOCK

The clock consists of a crystal oscillator, employing IC1, and a divider providing a division ratio of 5:1. Two gates from IC1, a 74LS00 quad NAND package, are connected as inverters with inputs biased-up by a low value resistor from the output. One is coupled to the other via C4 and positive feedback around the two inverters is provided via the crystal and series trimmer capacitor, C5. The latter provides slight adjustment of the crystal frequency. A third gate from IC1 is connected as an inverter and drives the divider, IC2. Two outputs of opposite phase are derived from pin 8 and pin 3 of IC1 for the colour encoder circuitry.



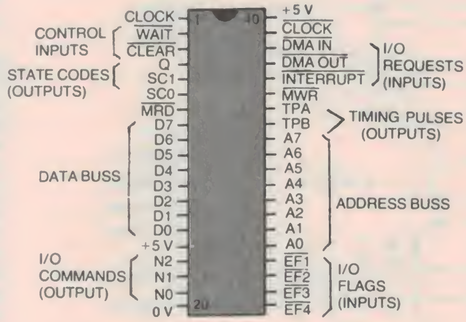
IC2 is a 7490 divide-by-10 counter arranged to reset on the fifth count. Its output, pin 11, is buffered and inverted by the fourth gate from IC1, IC1d, providing the required 1.773 MHz clock drive to the 1802 microprocessor.

CPU

The 'architecture' and operation of the 1802 were detailed in Part 2 of this series (June '81, pp. 103-108). However, there are a number of specific things to consider in relation to gross features of its operation.

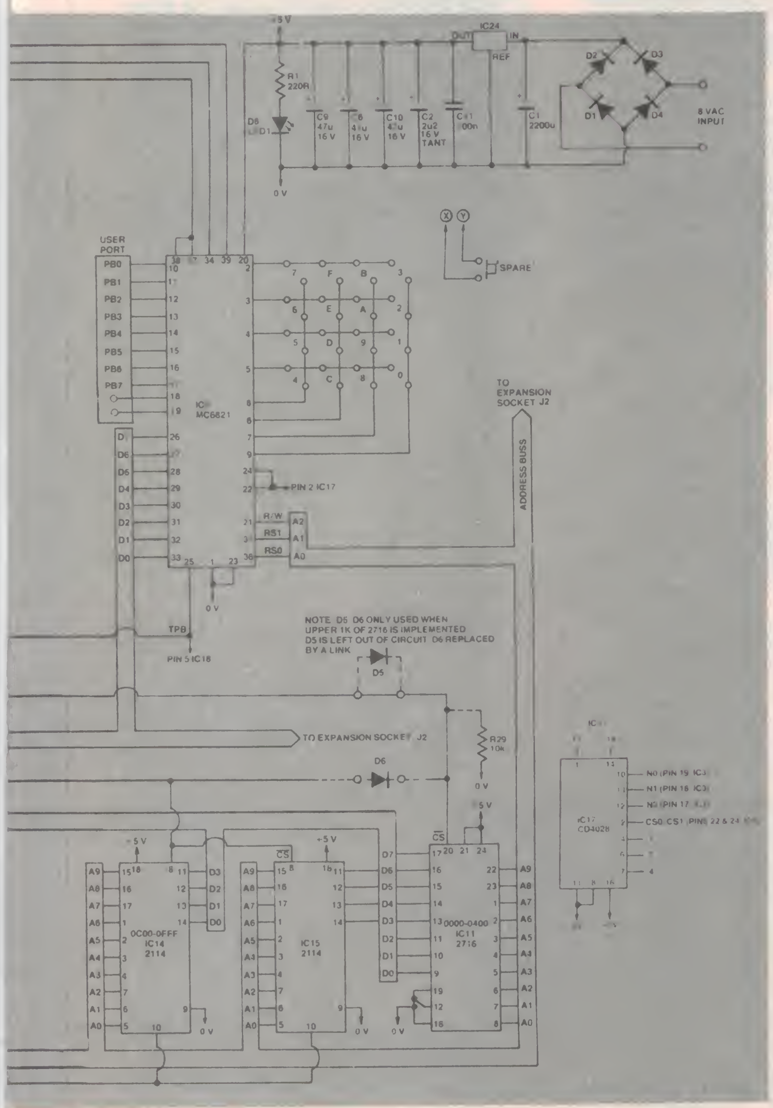
The STEP key applies a high (1) to one of the 'I/O Flag' inputs (pin 21) when pressed. This enables the processor to look at what the 6821 PIA is doing, via the data buss, and here it primarily permits instructions entered via the keyboard to be acted upon.

The 1802 generates two primary timing signals — TPA and TPB, available at pins 34 and 33, respectively. These are positive-going pulses that occur once each machine cycle (TPB follows TPA). They are used by I/O controllers (the 6821 PIA and 1864 Video Controller here) to interpret codes and to time their interaction with the data buss. The trailing (negative-going) edge of TPA is used by the memory system to latch the higher-order byte of the 16-bit memory address (see Part 2 of this series).



CDP1802 PINOUT TOP VIEW

This portion of the circuitry shows the ETI-660 set up for monochrome operation and with all the RAM in circuit.



The 1802 controls the memory operation via pin 35 (MWR). A negative pulse appears on this pin during a memory-write cycle and it drives the 'Write Enable' (WE) pin of each of the 2114 RAM chips (pin 10). It works in conjunction with the 'Chip Select (CS) signal derived by IC8 from IC6.

For video display purposes the 1802 provides a signal to the 1864 Video Controller which causes it to 'read' instructions from memory, via the data buss. This 'Memory Read' signal comes from pin 7 (MRD) and it goes low (0) to indicate a memory read cycle.

Input/output command signals come from pins 19, 18 and 17 — N0, N1 and N2 respectively. These are activated by an I/O instruction to signal the I/O control logic of a data transfer between memory and I/O interface. These are low at all times, except when an I/O instruction is being executed. During this time their state is the same as the corresponding bits in the N register. The direction of data flow is defined in the I/O instructions by N3 and is indicated by the level of the MRD signal (pin 7).

Here the N0-N3 signals go to a 4028 BCD-to-decimal decoder (IC17); it controls the 1864 Video Controller and the 6821 PIA.

The CLOCK input at pin 1 has a buffered output at pin 39, and this is used to drive the CLOCK input of the 1864 Video Controller.

CASSETTE INTERFACE

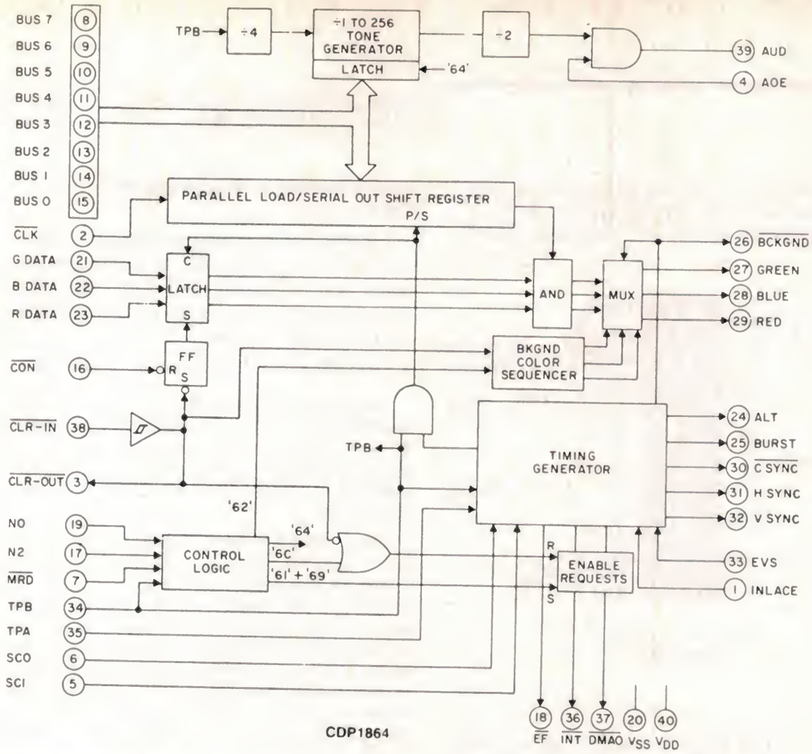
A useful feature of this project is the ability to store programs on audio (or 'data') cassettes using an inexpensive cassette recorder.

Programs are loaded onto tape in serial form (one bit after another) using two tones derived from the 'Q output' of IC3 (1802 CPU). This output is set and reset under program control.

Pin 4 of the 1802 drives the input (pin 6) of one section of an LM3900 quad op-amp (IC7). This acts as an inverting buffer. Its output drives a resistive divider network with a LED (D7 — LED2) in series with it. As pin 5 of the LM3900 goes up and down the voltage at the cathode of D7 goes up and down, turning D7 off and on. This provides a visible indication of program execution and tape loading and for this reason D7 is labelled "PULSE". The output from pin 5 of IC7 is attenuated to a suitable level by R25 and R26, the junction of these two resistors going to the TAPE OUT pin of J1, the cassette interface socket. Cassette recorders requiring a different level for recording may be accommodated by changing the value of R25 down or up to increase or decrease the level, respectively.

To load a program from tape, the cassette recorder's output is fed into another section of the LM3900 quad op-amp. The TAPE IN signal is fed via C8 and R32 to the input of this op-amp, pin 8. This is arranged to have a gain of 50, and the output, from pin 9, will drive from 0 V to +5 V with the correct level of input signal from the cassette recorder. Pin 9 of IC7 drives pin 23 of the 1802 CPU. This is a 'Flag' input that is testable by software to be either true or false. The serial data is converted by software into 8-bit code and loaded into memory, starting at an address designated by the user. The CHIP-8 monitor accomplishes all this — a '2' command effects a load onto cassette, a '4' command enables you to read a program from the cassette.

The data rate of the serial data is derived from the master clock period, and ETI-660 owners should have little difficulty exchanging software on tape.



VIDEO CONTROLLER

Internally, the CDP1864 Video Controller, IC4, consists of four major sections:

(1) A timing generator that produces the necessary signals for video interface operations;

(2) A parallel-in/serial-out shift register for screen dot generation;

(3) A programmable audio tone generator;

(4) Control logic for software control of the previous three sections.

The 1864 generates separate horizontal and vertical video synchronisation signals and a composite sync. For monochrome operation the composite sync. output (CSYNC — pin 30) is combined with the RED video output (pin 29) in a simple resistor network to produce composite video. Note that this is a high impedance output and cannot be connected directly to the 75 ohm input of most video monitors. Colour operation is more complex and is described later.

The 1864 produces a 'bit-mapped' colour or monochrome display with a maximum resolution of 192 lines vertically and 64 dots (eight 8-bit bytes) horizontally. This resolution, which requires 1.5K of refresh RAM, is seldom used because of the poor aspect ratio of the resultant picture element ('pixel'). An approximately square picture element is obtrained by repeating each horizontal line six times (done in sofware by the 1802) for a 32-row by 64-dot display. Whilst of lower resolution, this display only requires 256 bytes of refresh RAM.

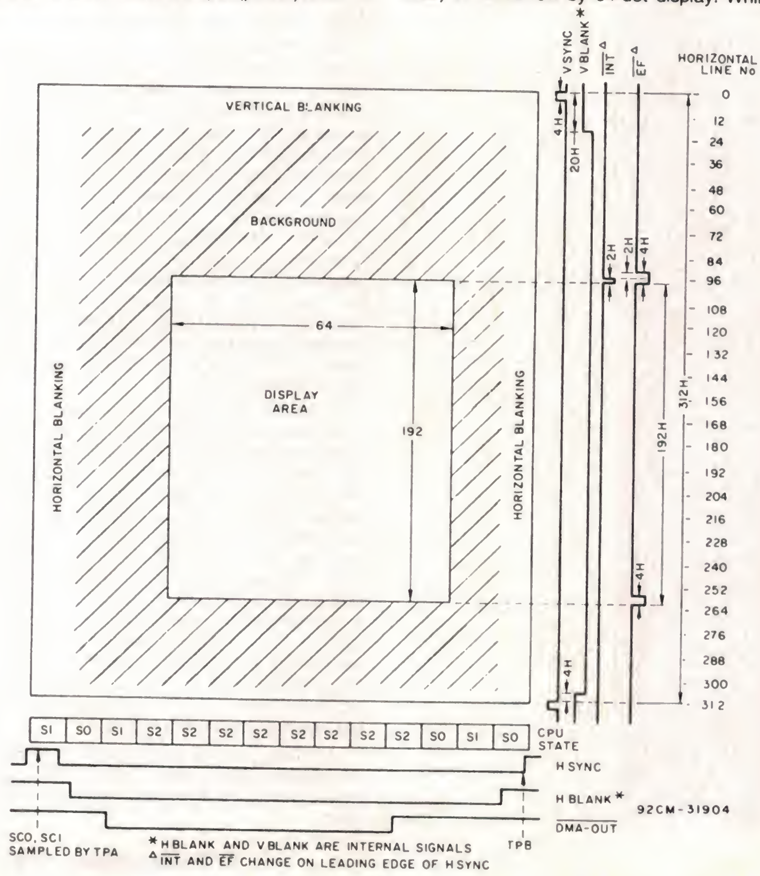
The programmable tone generator will produce 256 frequencies. Input is derived from the TPB signal from the 1802 (CLOCK ÷ 8 = 221.68 kHz). This is internally divided by four (55.42 kHz) followed by an 8-bit programmable up-counter and a ÷ 2 output stage. The programmable up-counter is reloaded automatically from the 8-bit tone generator latch each time it reaches the terminal count. The tone generator is loaded by the 1802 CPU from the data buss during a '64' output instruction.

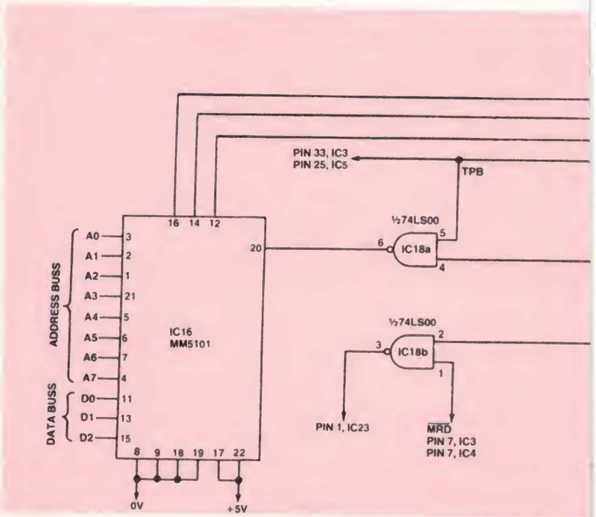
A high (1) at the 'Audio Output Enable' (AOE) input (pin 4) of the 1864 allows the selected frequency to be generated at the 'Audio Output' (AUD) — pin 39. A low (0) on pin 4 holds the output (pin 39) low. A speaker is driven from the AUD pin, via R20. The AOE input (pin 4) is driven from pin 4 of the 1802 CPU, which provides the cassette interface output. This provides an audio indication during cassette loading. The level on pin 4 of the 1802 is controllable by a single-byte machine code instruction, to be set or reset under program control. Audio 'prompts' are thus provided to indicate key pushes on the keypad from the monitor program resident in IC11.

Another of the functions of the 1864 is to provide 'Clear' and 'Interrupt' signals to the CPU and I/O controller. The 'Clear' signal output is from pin 3, the 'Interrupt' signal output from pin 36.

The RESET key is connected to the 'Clear Input' (pin 38) of the 1864. Pressing this key puts a low (0) on pin 38 and the internal logic virtually starts the Video Controller, and subsequently the 1802 CPU and 6821 PIA, from scratch. Internally, pin 38 is the input to a Schmitt trigger. This allows the use of a simple RC network (R2, C3) for power-on reset and debounce of the RESET key. When power is first turned on, C3 will be initially discharged, holding pin 38 low until it charges (about 10 ms or so) via R2. When the operator presses the RESET key, C3 discharges and any contact bounce is suppressed by the RC network R2-C3.

On applying reset, the colour, control, interrupt and DMA requests are disabled, making it necessary to include the colour enable software in the initiation routine (from the monitor program resident in IC11).





COLOUR ENCODER

Additional circuitry is required to obtain colour video operation. This involves ICs 16 to 21, additional resistors and the colour delay line, DLY1. The 1864 Video Controller is employed to its fullest extent when colour operation is effected.

The video encoding circuitry is much more complex, as the composite video must contain composite sync, luminance and chrominance information. The luminance signal is obtained by combining the three colour outputs (RED, GREEN, BLUE) plus the background output (BKG) from the 1864 in a resistor matrix — involving resistors R4, R5, R6, R7, R8 and R10. The composite sync signal ($\overline{\text{CSYNC}}$) is added in via R11. The value of each of these resistors is chosen so that the correct portions of each hue (colour) are added together to produce its correct luminance level. The background output is included in the matrix so that the luminance of background colour can be controlled, especially if the same colour is used for data in the display area.

It is more difficult to produce the chrominance signal, as it has to be phased correctly with reference to the burst pulses generated by the main crystal oscillator. To produce a PAL-compatible colour difference signal, outputs of IC20 are switched to the composite video output by a quad bilateral switch, IC21 (a 4066) via a resistor network R12-R19. The outputs of the two flip-flops in IC20 are switched through in sequence, driven by two opposite-phase signals from the 8.86 MHz clock, gated with the ALTERNATE output from the 1864 Video Controller. Each switch in the 4066 is driven by a video signal output from the 1864 (BURST, BLUE, GREEN, RED). This ensures the weighting resistors are switched through with the appropriate synchronism. The clock frequency (8.86 MHz) is twice the colour burst frequency of 4.43 MHz because of the divide-by-two action of the flip-flops in IC20.

The 400 ns delay line (DLY1) is included in the luminance line to compensate for the propagation delay of the colour signal in the encoder circuitry, achieving best results with colour operation.

Colour bit information is obtained from an additional RAM, IC16. This is selected as an I/O device by the I/O line decoder, IC17. Data is loaded into it from three lines of the data buss on application of the TPB pulse from the 1802 CPU. This is gated with an output from IC17 to effect the Chip Select signal in a NAND gate, IC18a, one section of a 74LS00 quad-NAND gate. IC17 is a one-of-10 decoder that is used to decode the N bits (N0, N1, N2 — the I/O command bits) from the 1802 CPU to produce individual 'valid' lines for output or input codes (in hex, commands 61 to 67 and 69 to 6F). IC16 is a 256 x 4 bit RAM chosen because it has separate data input and output lines, making it easier to connect between the data buss and the 1864.

The 'video refresh' is accomplished via the DMA bit of the 1802 CPU, and synchronisation is provided by the $\overline{\text{INT}}$, $\overline{\text{EF}}$ and State Code lines SC0, SC1. The latter are used to synchronise the 1864 to the 1802, providing a jitter-free display.

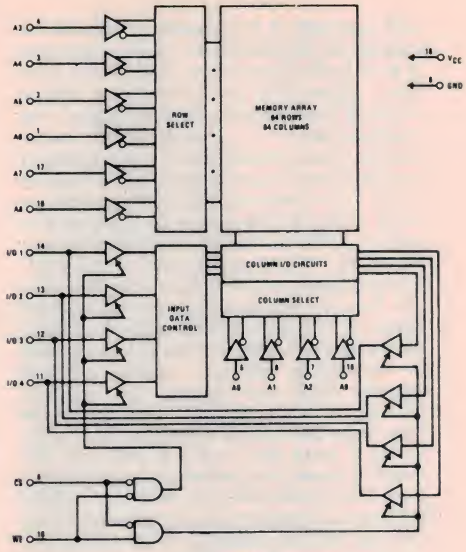
RAM

The random access memory (RAM) uses 2114 ICs which are 1024 x 4 bit static RAM chips. This type of RAM is easy to use because being a 'static' type it requires no clocks or 'refreshing' as does 'dynamic' RAM. Power consumption, however, is higher, but can be offset by using slightly more expensive CMOS RAM chips, which we have done. The 2114 RAM is TTL signal and power supply compatible; data output has the same polarity as input data and shares the same I/O lines.

Internally, the memory array is arranged in a 64 x 64 block. Decoding is done by 'row' and 'column' select signals to produce a 1024 x 4 bit arrangement. With only a 4-bit data input it is necessary to use two 2114 chips per 1K (1024 byte) block of memory as this machine uses an 8-bit data and address buss.

To enable access to each individual 'word' of the 1K block, it is necessary to use address lines A0 to A9. When the particular RAM is not required, it is isolated from the data buss by taking the 'Chip Select' line (CS — pin 8) high. This forces the I/O lines into a high impedance state.

'Reading' and 'writing' of data to and from memory is controlled by the 1802 CPU. When the $\overline{\text{MWD}}$ line (pin 35 of IC3, connected to pin 10 of each 2114) is low (0) and the Chip Select inputs of the appropriate 2114 pairs are low (pin 8), then data can be written into the RAM. When the Chip Select inputs are low and the $\overline{\text{MWD}}$ line high, data may be read from RAM.



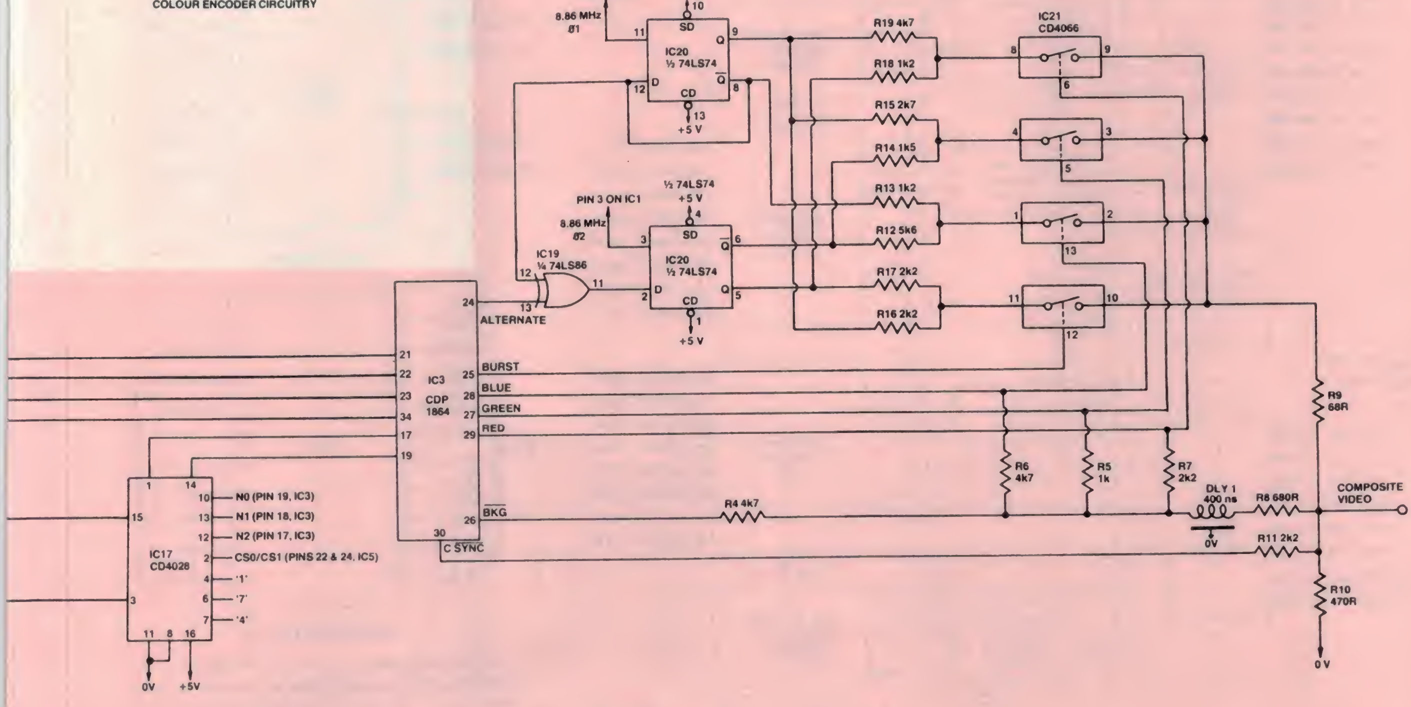
2114

The RAM chips are arranged in pairs, giving 1K blocks; IC9 and IC10 are for the 0400 to 0800 block of memory, IC12 and IC13 for the 0800 to 0BFF block, IC14 and IC15 for the 0C00 to 0FFF block. The CHIP-8 monitor program in IC11 occupies the 0000 to 0400 block of memory, but it is Read Only Memory (ROM) and we'll come to that shortly. For the minimum amount of RAM only IC9 and IC10 are required.

In Part 2 of this series the need for IC6, a 7475 4-bit address latch, was discussed. Its function is to demultiplex the higher order address lines A8 to A15. During the time the TPA output from the 1802 is low, the 7475 puts the data that was on address lines A0 to A3 when TPA went low onto address lines A8 to A11, while the 1802 CPU switches the lower order address byte onto the address buss lines A0 to A7. That's fine, but IC6 performs another function, in conjunction with IC8.

To select the correct RAM chips for the designated memory address during a memory read or ▶

COLOUR ENCODER CIRCUITRY



write operation, it is necessary to activate the appropriate Chip Select line — pin 8 on each pair of 2114 RAM chips for each 1K block. The Chip Select signals ($\overline{CS}$) are generated by IC8, a 74LS138 3-to-8 line decoder/demultiplexer. The inputs are pins 1, 2, 3 — the latter is held low (0), and bits 10 and 11 (A10 and A11) of the address buss drive pins 1 and 2, from the latched outputs of IC6. The outputs of IC8 are active low (they go to 0 V to provide Chip Select). On power-up A10 and A11 will be low and pin 15 of IC8 will be low, driving the Chip Select input of IC11 (the ROM, which contains the CHIP-8 monitor program) low, and thus the monitor program is available on power-up. The 1802 CPU provides the appropriate address signals to A10 and A11 for selectng the appropriate sector of memory, and IC8 decodes these two address bits and the appropriate output pin goes low, driving the Chip Select pins on the appropriate RAM chips low. E.g: when pin 14 of IC8 goes low, this selects IC9 and IC10, which serve the memory block from 0400 to 0800 (1K). When pin 13 of IC8 goes low this selects ICs 12 and 13; when pin 12 of IC8 goes low, this selects ICs 14 and 15 (the 'top' 1K of the on-board 3K of RAM).

It should be noted that data is read out of RAM non-destructively — you can read memory locations as often as you like and the data residing there will remain there until such time as you alter or remove it. The data read out has the same polarity as the data written into memory locations.

INPUT/OUTPUT

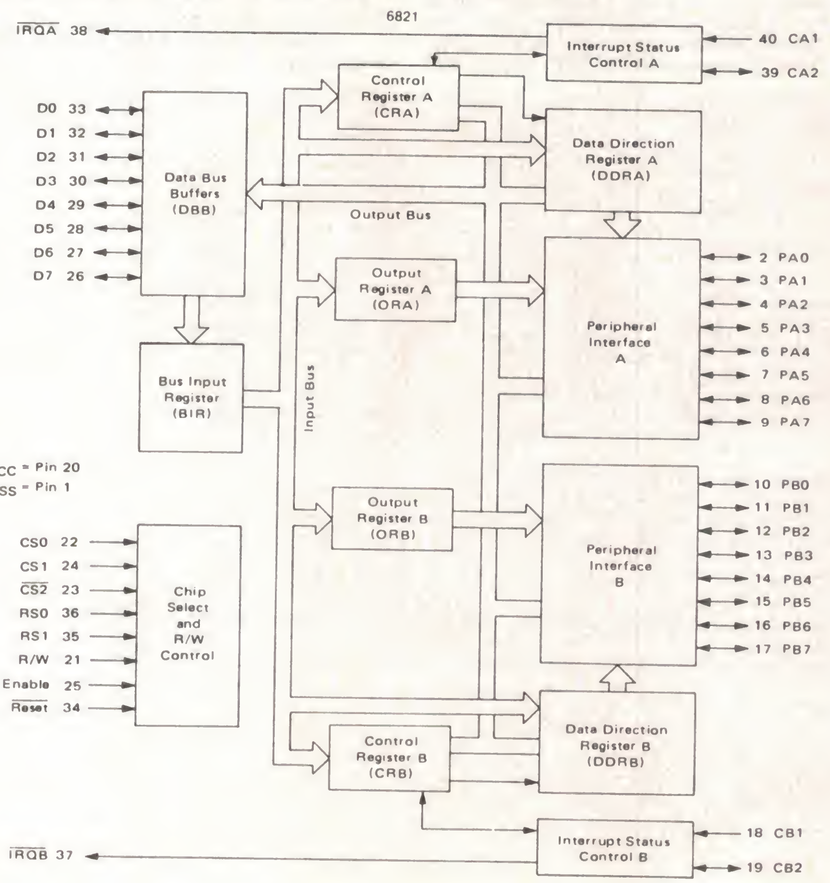
The MC6821 (IC5) Peripheral Interface Adaptor is a software-programmable I/O device that allows connection between the microprocessor and 'the outside world'. This IC comprises two completely separate 8-bit I/O ports — PA and PB — and four control lines, two per port, CA1-CA2 and CB1-CB2. On the 8-bit ports any bit (or line) can be software programmed to be an output or an input. CB1 (pin 18) and CA1 (pin 40) are only usable as inputs — mainly used to effect hardware interrupts. CB2 (pin 19) and CA2 (pin 39) can be used as inputs or outputs, but not in the same way as the 8-bit lines. Port B involves pins 10 to 17 (bits 0 to 7), which are brought out to pads on the board for external connection, alongside pin 18 (CB1) and pin 19 (CB2).

Internally, each section — PA or PB — contains (i) a Control Register (CRA or CRB), (ii) a Data Direction Register (DDRA or DDRB). It is the function of the DDR to program the individual bits of the output register to be inputs or outputs. The Control Register is used to direct data on the data buss to DDR or the Output Register. After a hardware reset is done it is necessary to initialise the Output Register by using software in the monitor program resident in IC11.

The PA section of IC5 is used in conjunction with the keyboard. This is divided into a 4 x 4 matrix with a normally open contact at each cross point. Pins 2 to 5 connect to the 'columns' of the matrix, while pins 6 to 9 connect to the 'rows' of the matrix. Internally, these eight lines have pull-up resistors, and when used as inputs are normally high when open. The 'row' lines (pins 6 to 9) are made output lines and are programmed in software to be logic 0. Pressing any key will join a row line (low) to a column line (high), pulling the column line (an input) low. The software (monitor program) detects this and changes the function of the rows and columns over to find the key depressed. Some short delay is normally included to 'debounce' the key contacts. Software is used to determine the 'value' of the key depressed.

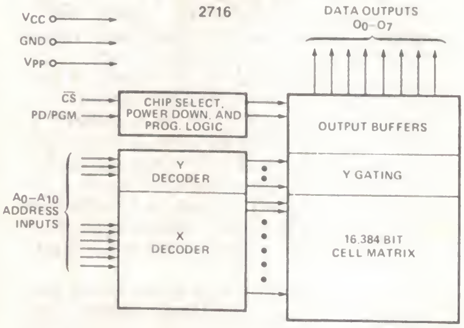
The PB section is user available but will require some additional machine code to program it.

The 6821 PIA and internal registers are selected by a combination of decoded 'N' lines from the 1802 (pins 17, 18, 19 — I/O command lines N2, N1, N0 respectively) and the lower-order address lines A0, A1, A2. The latter connect to pins 36, 35 and 21 respectively of the 6821 — these being inputs to the 'Chip Select & Read/Write Control' logic inside IC5. The CPU's N lines are decoded by IC17, a 4028 BCD-to-decimal decoder, one of its outputs driving two inputs to the control logic of the 6821.



ROM & CHIP-8

The CHIP-8 monitor program is contained in IC11, a 2716 or 2516 Programmable Read-Only Memory. This device is a 2Kbyte by 8-bit ultraviolet-erasable and electrically programmable ROM (EPROM). The 16 384-bit memory array inside the chip is decoded by 'X' and 'Y' decoders driven from the A0 to A9 address

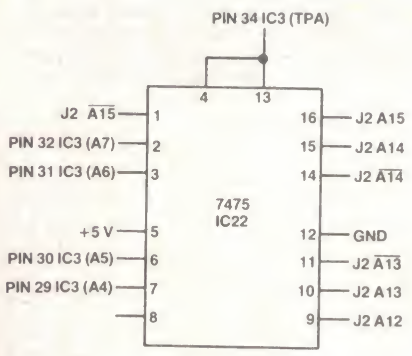


lines here, which gives 2048 8-bit 'words' of memory. Only half is used — the 'lower' order of memory. The 'higher' order (or upper half) may be programmed at a later date and provision has been made on-board to select the lower or upper half of ROM if necessary.

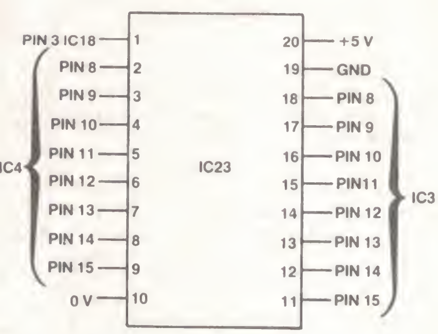
As explained before, a Chip Select signal is derived from IC8 and ROM is selected on power-up. As it is a read-only memory, no R/W control is required from the 1802 CPU.

EXTRAS

Provision has been made for later expansion of the project. For further RAM, the higher order address lines are decoded by adding IC22, another 7475, which functions in much the same way as does IC6. A data buss buffer, IC23, has to be added if external RAM is added. The expansion socket J2 povides connection to external RAM.



HIGH ORDER



DATA BUSS BUFFER

To use the upper 1K of the EPROM, IC11, two Chip Select signals are gated together in a simple diode gate — D5 and D6. Normally, D6 is replaced by a link on the board so that the ROM Chip Select signal is connected to IC11 and D5 is left out. R29 acts as a dc return when D5 and D6 are inserted. ●

(Article continues page 43.)

Bill Edge's ELECTRONIC AGENCIES

115-117 Parramatta Road Concord 2137
(Corner Parramatta Road & Lloyd George Ave)
Telephone: (02) 745 3077 (two lines)

All prices correct & goods in stock at time of going to press. Please phone to check current availability

Mail orders: PO Box 185 Concord 2137

TRADING HOURS
Mon-Fri 9am-5.30pm
Saturday 9am-noon
Sunday 10am-2pm

MAIL CHARGES

$5-$9.99	$1.00
$10-$24.99	$2.00
$25-$49.99	$3.00
$50-$99.99	$4.00
$100 or more	$5.50

All heavy or bulky items (over 20kg) sent Comet Road Freight: $8.00 anywhere in Australia.

what else do we carry? HI-FI ★ KITS ★ PA EQUIPMENT ★ MIKES ★ HARDWARE ★ TOOLS ★ WIRE ★ SEMIS ★

WE ARE THE KIT SPECIALISTS We try hard

We try hard to maintain a very high standard with our kits:

1. Unless advertised otherwise all our kits come complete down to the last nut and bolt – and even include solder.
2. Many of our kits can be seen working in our store – can our competitors top that?
3. Absolutely every component in our kits is new and guaranteed.
4. We often have our kits assembled by people like Phil Wait (technical writer for ETI) and Fred Lever (electronics engineer) who re-write our instructions so that they are perfect when you, our customer, goes to work on one
5. Our kit manager has spent several years controlling kit assembly and makes sure our kits are turned out perfectly
6. Our range of kits is also one of the biggest in Australia – you have more to choose from.
7. Latest – we never let a good project pass us by – if there is something new in electronics we are usually first with a kit for it.
8. Special parts for kits – unlike some kit suppliers we have all special parts available separately – like brass rods, special heatsinks, coils etc.
9. All our kits come complete with instructions.
10. Our prices for quality kits cannot be beaten!

Money back if not satisfied within 7 days

Walkabout cassette with phones

The latest in mobile music. Fantastic sound – save up to $20 on other brands. Cat. AE5000

$79 Save $20 on others

FABULOUS MAGNAVOX SPEAKERS

A range of top quality wide range speakers

SOUND VALUE

8WR
Power handling .... 25W RMS
Resonant frequency 35Hz
SPL @ 1W @ ½m 94dBSPL
Frequency resp 45-15kHz
Cat. CE2335 **$14.95**

10WR
Power handling .... 25W RMS
Resonant frequency 35Hz
SPL @ 1W @ ½m 95dBSPL
Frequency resp 50-14kHz
Cat. CE2345 **$18.95**

12WR
Power handling .... 25W RMS
Resonant frequency 30Hz
SPL @ 1W @ ½m 93dBSPL
Frequency resp 50-14kHz
Cat. CE2355 **$21.95**

COMPARE OUR TOP VALUE PLAYMASTER MOSFET AMPLIFIER

A superb amplifier kit giving 50WRMS per channel – complete with instructions plus a step by step guide showinghow our technician built it EXCLUSIVE to Electronic Agencies. Our kit looks great and performs superbly – we even have one made up on demonstration. Our front panel design is the original front panel design – beware of imitations. Cat. KE4180

COMPLETE KIT WITH FERGUSON TRANSFORMER

SAVE $27 THIS MONTH ONLY – WAS $169 **$142**

ALL PARTS AVAILABLE SEPARATELY

Transformer Cat. ME2361	$35.00
Case Cat. HE7050	$19.50
Drilled heatsink Cat. HE2430	$10.50
PCB 80SA10 Cat. HE9388	$12.50
Front panel Cat. HE7800	$15.00
Tapped pot Cat. RE1263	$2.95

NEW PRODUCTS

10cm speaker
Ideal for all applications needing a super compact wide range speaker. Cat. AE8130 $4.95

Turntable hinges
Very limited quantity of top quality hinges to suit turntable lids etc. Cat. CE2002 pair $3.95

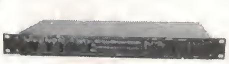
Blank PC boards
Limited quantities only
10cmx10cm bakelite Cat. HE4500 20¢
10cmx10cm fibreglass Cat. HE4543 49¢

SUPER SPECIAL IC SOCKETS

18 pin PE3278 40¢ was 65¢
22 pin PE3290 NEW 50¢
24 pin PE3338 was 90¢ 50¢
28 pin PE3342 80¢
40 pin PE3348 was $1.10 70¢

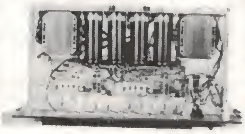
ETI5000 Pre Amp $245

Come in and hear the fantastic combination of the ETI5000 power amp & preamp playing through the ETI4000/1 and 2 speaker systems.



ETI Power Amp ONLY $295

The front panel is now better finished than ever, and has no holes visible. The fins themselves are tapped from the rear. Complete kit price is just $295. Remember – our kit has the specially designed professional folded case and the super finish front panel at no extra charge.



QUALITY SOUND TV-HIFI Adaptor

Connect your TV to your hifi system – without bad side effects. 1 3.5mm plug connects to TV 2 RCA plugs to amp, 2m lead. Cat. HE5293

$7.95

WIND SPEED INDICATOR

See Oct EA

Ideal for sailing buffs or anyone who wants to know wind speed remotely (why get blown about?) Complete kit as per the magazine article. **$44.50**

New ICs used in ETI660

2716 Pre programmed	ZE5500	$17.50
6821	ZE5505	$4.50
CDP1802	ZE5510	$9.90
CDP1822	ZE5515	$8.50
CDP1864	ZE5520	$13.00

ETI-660 Computer Kit

Here's the super economy computer you've all been waiting for. Complete kit including PCB, all ICs and components (pre-programmed 2716 ROM included) and IC sockets. Cat. KE6600 $99.00

Cat. KE6601 Keypad to suit includes 18 keys and Scotchcal™ labels for keys	$32.00
Cat. KE6602 Colour option	$13.50
Cat. KE6603 Video RF modulator including die-cast box	$14.50
Cat. ME7712 Plugpack to suit 8VAC/1A	$11.95
Cat. HE9660 Double sided glass PCB	$29.50
Cat. SE1000 Pushbutton keys only	$1.90

OPEN SUNDAY 10AM TO 2PM

$99

MISS OUR CATALOGUE?

Copies are still available of our catalogue. Yours for the asking at our store or send 75¢ P&P and we'll send one to you.

LATEST KITS

ETI Low ohms meter
Accurately measures very low resistances – measures critical cable resistances and emitter resistors etc that a multimeter couldn't cope with. ETI158 Nov Cat. KE1877 **$29.50**

EA Sand glass
The solid state egg timer to end all! Intriguing 'hourglass' design has the character of the traditional timer – with the accuracy of electronics. See EA Nov Cat. KE1027 **$23.50**

EA Traffic Buzzer
If you have trouble hearing your indicators – in open cars, bikes, over loud stereos or if it just isn't loud enough – here's the answer. Easy to build and install. See EA Nov Cat. KE0193 **$7.50**

Photon Torpedo
The low cost alien exterminator! Great way to kill time (and aliens!) on boring train trips etc. Compact, self contained game. See EA Sept Cat. KE1010 Complete kit $23.50

Scratch & Hiss filter
From Hobby Electronics October. Super simple, super cheap way to cut hiss on your cassettes. Cat. KE1085 Includes PCB, switch, components only $9.95

IC SPECIALS THIS MONTH ONLY

LM393	ZE5393	$1.10
CA3140 (DIL)	ZE5140	$1.10
BF469	ZE0445	70¢
BF470	ZE0455	70¢

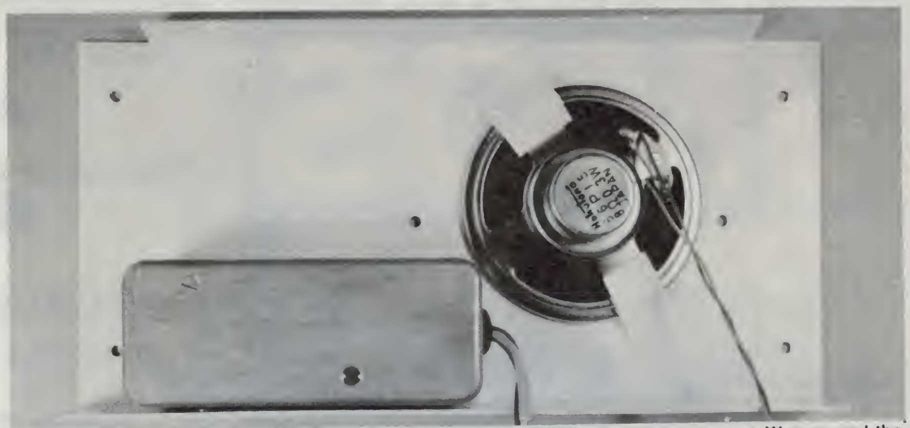
A big thankyou

Thank you for such a fabulous response to our catalogue. We are trying to hold the catalogue prices as long as possible – but due to the sales tax increases some prices may have to go up – we're sorry

Project 660

— from page 33.

Housing the 660



The 760 RF Modulator mounts to the top cover with its own cover retaining screws. We secured the 50 mm speaker with two sticky pads.

We chose to house the 660 in a simple, open case that may be readily constructed in the home or school workshop. It consists of a bottom piece on which the 660 pc board mounts, a top cover on which the speaker and 760 modulator mount and two wooden sides which complete the whole assembly. Mechanical drawings are available from us to enable you to make up the various parts of the housing. The top and bottom pieces are easily bent up with a simple bender or with two pieces of wood held in a vice. We used aluminium as it's easy to work with, but galvanised mild steel may be used if you wish.

The top and bottom pieces should be cut to size and then drilled before bending up. The bottom has four holes to accommodate the stems of four 'mushroom-shaped' rubber feet. You can omit these holes and use 'stick on' rubber feet if you wish.

You will notice a large cutout on the rear foldup of the bottom piece. This is to permit access to the expansion part on the pc board (J2) later. The cassette interface DIN socket mounts on this rear foldup. We spray-painted the top and bottom plates white after they were drilled and bent up.

The components of the housing may be obtainable from some kit and component suppliers, either separately or with kits, if you don't wish or are unable to make them yourself.

Before assembling your 660 into its housing, first make the 8 Vac input lead to the board a permanent attachment. The figure-8 cable is looped through the two 4 mm diameter holes in the pc board adjacent to D1-D4 and the wires then soldered to the 8 Vac input pads.

Next take a twisted pair of hookup wires about 220-250 mm long and solder them to the SPK terminals on the pc board (near the end of C1). Now take three lengths of different coloured hookup wire about 200 mm long and solder them to the cassette interface connections on the pc board (J1). At this stage we will assume you already have your 760 modulator connected to the 660 pc board.

Now you can assemble the 660 pc board to the bottom piece of the housing. You will need five 12 mm long, 6 BA bolts and a total of 15 nuts. Pass a bolt through each mounting hole from the underside of the bottom plate and secure each with *two* nuts. These serve to space the pc board off the bottom plate. The bolt adjacent to the DIN socket hole has a 'star' washer secured beneath its head to provide an 'earth' connection to the 0 V track on the pc board. Now place the pc board over the mounting bolts. If all the holes are accurately drilled it should fit with little difficulty. If not, you will have to enlarge the appropriate hole or holes in the pc board a little until the board fits properly. Secure the board with *four* nuts — the exception being on that bolt adjacent to IC16. (The one with the star washer under its head). Fit a washer and a solder lug under the nut on this one and solder the lug to the 0 V track that runs around the end of the board here. (See accompanying photograph).

Now mount the cassette interface DIN socket to the foldup on the bottom piece and wire it up — making sure you have it correctly connected as per overlay drawing 3 or 5.

MECHANICAL DRAWINGS, PCB, ETC.
Detailed mechanical drawings, pc board artwork and Scotchcal artwork (for the keyboard) can be obtained from us by sending a stamped, self-addressed envelope (at least 300 x 250 mm) to ETI-660 ARTWORK, ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011.

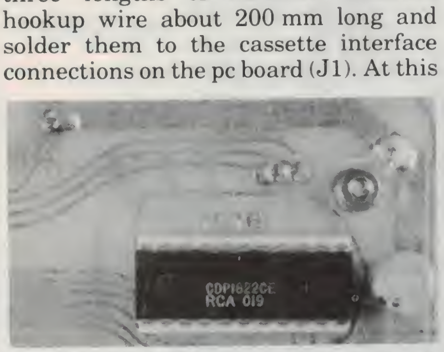
The wooden side pieces may now be screwed to the bottom plate. Note that these are each secured by three screws on the underside and one screw on the rear foldup. We used small pan-head PK screws.

The 760 modulator may be attached to the top plate at this stage. Its orientation is fairly obvious — the RF output socket goes beneath the 15 mm diameter hole. The screws that are supplied with the diecast box to secure its lid are here used to secure the box to the top plate of the 660 housing. Two access holes are provided in the top plate — one for the RF output connector of the modulator and one for tuning tool access to the 760's oscillator trimmer.

The speaker may now be secured to the top plate. There are several ways to do this. We used sticky pads to hold the speaker frame to the underside of the top plate. Alternatively, the speaker could be glued in position using a rubber compound such as 'Silastic'. You could also drill a couple of holes on opposite sides of the speaker position, just outside the diameter of its frame, and bolt the speaker in place using large washers to clamp the edge of its frame. We'll leave this up to you as precise details will depend somewhat on the physical dimensions of the speaker you're using.

Once you have the speaker in position, wire it up. The top plate may then be screwed in position to complete the housing. Note that two screws secure the top plate to the wooden side rails and we used small PK screws, as before. Last of all, attach the four rubber feet to the bottom plate.

That completes the mechanical assembly, and you're ready to roll! ●



The bottom plate of our housing was 'earthed' to the 0 V track on the pc board via a solder lug under the mounting bolt adjacent to IC16.

Make up a cassette interface cable. The DIN plug goes into the 660 and the two jacks to the recorder. To distinguish between the TAPE IN and TAPE OUT cables we made one longer and with a different coloured jack to the other.

The **ZX PRINTER** — designed for use with ZX81 and ZX80 with8K BASIC ROM. Alpha-numerics! Graphics!

sinclair ZX81 PERSONAL COMPUTER

$250 COMPLETE

sinclair

COMPLETE WITH MAINS ADAPTOR, LEADS, ONLY $250

16K-BYTE RAM PACK $150

Higher specification, lower price — how's it done?

Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

The ZX81 comes complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

New, improved specification

- Z80 a microprocessor — new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function — useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer (not available yet — but coming soon)!
- Advanced 4-chip design, microprocessor, ROM, RAM, plus master chip — unique, custom-built chip replacing 18 ZX80 chips.

ZX Software Cassettes

Send for free catalogue of Games, Business, Educational, Junior Educationa. Encl. S.A.E.

FREE NEW BASIC ZX81 MANUAL

If you own a Sinclair ZX80 . . .

The new 8K BASIC ROM used in the Sinclair ZX81 is available to ZX80 owners as a drop-in replacement chip. (Complete with new keyboard template and operating manual.)

With the exception of animated graphics, all the advanced features of the ZX81 are now available on your ZX80 — including the ability to drive the Sinclair ZX Printer.

ORDER FORM — SINCLAIR EQUIPMENT (AUSTRALASIA) P/L

86-88 Nicholson Street, Abbottsford, Victoria, 3067. Telephone: 419 3033.

QUANTITY	ITEM	ITEM PRICE	TOTAL
	Ready assembled ZX81 Sinclair Personal Computer including mains adaptor, leads, BASIC manual	$250	
	16K-BYTE RAM pack	$150	
	8K-ROM (only required for ZX80)	$ 75	
	ZX Printer (to be announced)		

Total ______

I enclose cheque/Bankcard/Diners/Amex ☐☐☐☐☐☐☐☐☐☐☐☐☐

Name ______

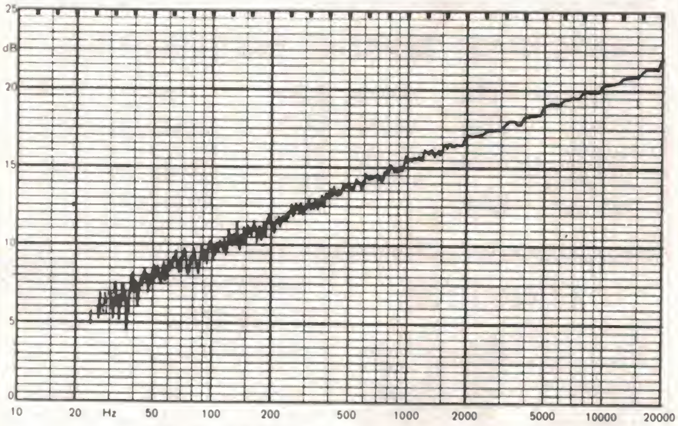
Address ______ Postcode ______

Signature ______

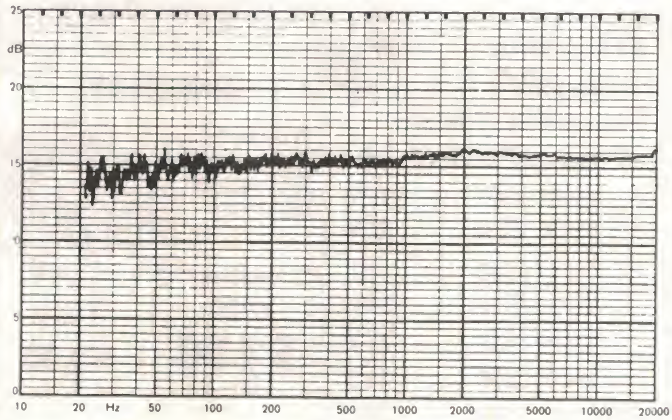
ETI

Audio 'white noise' generator employs digital technique

This project has many and varied applications, from a test signal source for audio systems through to a noise source for a 'sound effects' unit.



Measurement of the amplitude of white noise versus frequency as measured with a one-third octave filter set.



Measurement of the amplitude of pink noise versus frequency as measured with a one-third octave filter set. To the ear, pink noise appears to have more bass content.

WIDEBAND, or 'white', noise is a curious phenomenon, as it is a signal that contains a very wide spectrum of randomly distributed frequencies, all with random amplitudes, but it has equal amounts of energy in equal bandwidths over the total frequency range of interest. If you measured the noise energy in the band between 100 Hz and 200 Hz, for example, it would be the same as the energy between 3000 Hz and 3100 Hz, or 10 000 Hz and 10 100 Hz. That is, when the energy in a particular band is averaged over a reasonable unit of time it will have the same power as that in the same bandwidth anywhere else in the spectrum.

The basic sound of white noise resembles that of steam escaping from a valve. Electronic 'steam train' effects employ a white noise source to generate the basic sound. Electronic music synthesisers include a white noise generator that can be employed to generate a variety of effects with suitable modification.

White noise and 'pink' noise are used for audio system testing in a variety of ways, which we don't have space to go into here. Pink noise is a modified version of white noise, where the signal is filtered to produce noise that has equal energy per percentage change in bandwidth. For example, the energy in the band 100 Hz to 200 Hz would be equal to that between 3 kHz and 6 kHz — a 100% change in bandwidth in each case.

To hear it, pink noise appears to have more bass content than white noise and also appears to the ear to have a more uniform output level in audio testing. To change white noise to pink noise, a filter is required that rolls off with decreasing frequency at 3 dB per octave (10 dB per decade).

As this project has application in a variety of areas we have not provided details of housing the board as it may be built into some existing or planned equipment, used on its own, or used with filters and attenuators to suit your particular application.

Making noise

There are several ways to generate white noise. Mother nature provides us with many sources in the electronic world, and an often-used source is the noise generated by a zener diode. We used this technique in the ETI-441 Audio Noise Generator (Jan. '76). However, it has the drawback that the output level is low and results vary widely from diode to diode.

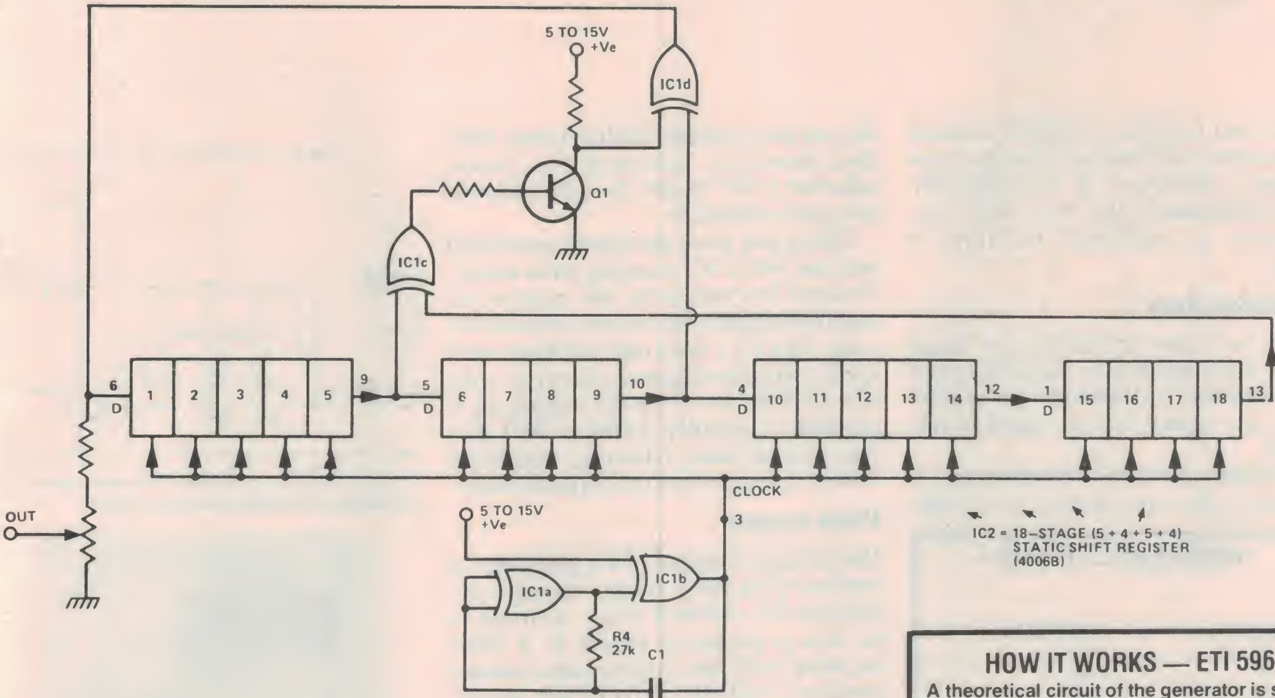


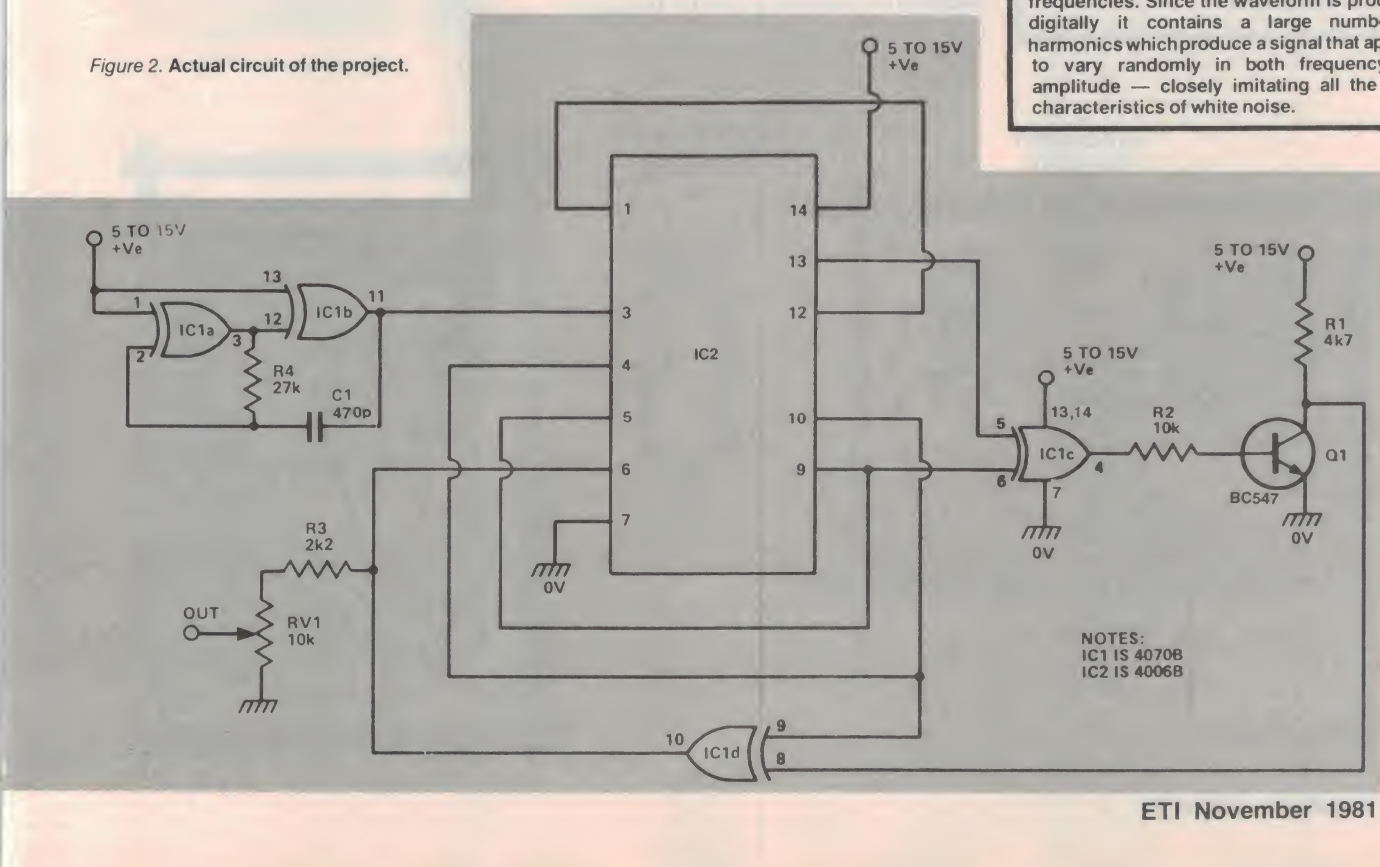
Figure 1. **Theoretical circuit, illustrating the operation of the shift register.**

HOW IT WORKS — ETI 596

A theoretical circuit of the generator is shown in Figure 1. IC2 is an 18 stage (5+4+5+4) static shift register, in which the logic (0 or 1) information on the data (D) terminal is fed forward one step on the arrival of each pulse from a 60 kHz oscillator, IC1a-IC1b. Exclusive-OR gates IC1c-IC1d are used in conjunction with an inverter, Q1, to feed various outputs of IC2 back to the first data terminal in such a way that the data feeds through the register in an apparently random or jumbled fashion.

In reality, a complex sequence of 0s and 1s flows through the register, repeating once every few seconds and producing the apparently random jumble of fundamental frequencies. Since the waveform is produced digitally it contains a large number of harmonics which produce a signal that appears to vary randomly in both frequency and amplitude — closely imitating all the basic characteristics of white noise.

Figure 2. **Actual circuit of the project.**



This unit employs a 'digital' method of generation and is similar to the noise generator employed in the ETI-601 4600 Synthesiser (Oct. '73 — July '74). Operation is explained in 'How It Works'.

Construction

Whilst we have provided a pc board design, the project may be constructed on Veroboard, Uniboard or matrix board as layout is not particularly critical.

No particular order of construction is necessary, but take due care with the ICs, as they are both CMOS types. Note that there is a link on the pc board, adjacent to R1. Watch the orientation of the semiconductors.

When you have the board assembled you can test if it's working quite easily. Connect the output to the input of an audio amplifier of some sort via shielded cable. Set RV1 *fully anti-clockwise* and apply a supply of between 5 and 15 volts (the unit draws only a few milliamps of current). Carefully advance RV1 and you should hear a hissing sound not unlike frying or that of escaping steam.

PARTS LIST — ETI 596

Resistors all ½W, 5%
R1 .... 4k7
R2 .... 10k
R3 .... 2k2
R4 .... 27k

Potentiometer
RV1 .... 10k

Capacitor
C1 .... 470p ceramic

Semiconductors
IC1 .... 4070B
IC2 .... 4006B
Q1 .... BC547, BC107 etc.

Miscellaneous
ETI-596 pc board.

Pink noise

Modifying the output of the generator to produce pink noise simply requires the addition of a suitable filter. A circuit to do this is shown in Figure 3. A filter network with the appropriate characteristics (roll-off of 3 dB per octave above 20 kHz) is connected in the negative feedback circuit of a simple common emitter amplifier stage employing a BC548. Tantalum capacitors are recommended for the two polarised capacitors shown at the input (25u) and the output (1u). They should be rated at 16 V or more. The white noise input should be taken from the wiper of RV1 in the noise generator. Layout is not critical. A 220u/16 V electrolytic bypass capacitor is recommended for the supply rail.

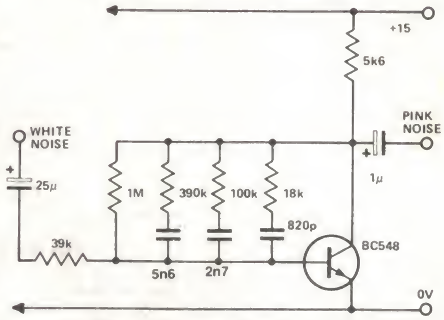
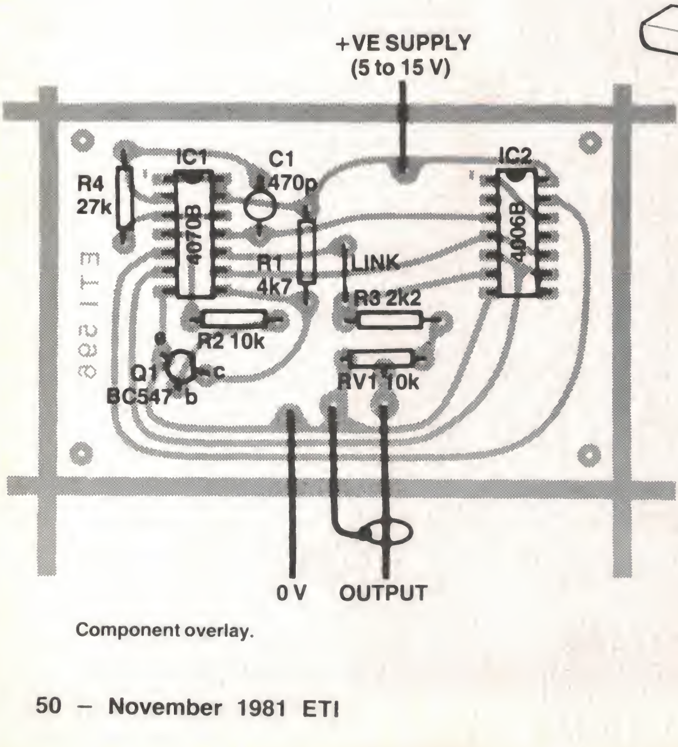
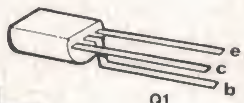
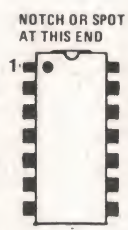


Figure 3. **A filter circuit to produce pink noise from the output of the white noise generator.**

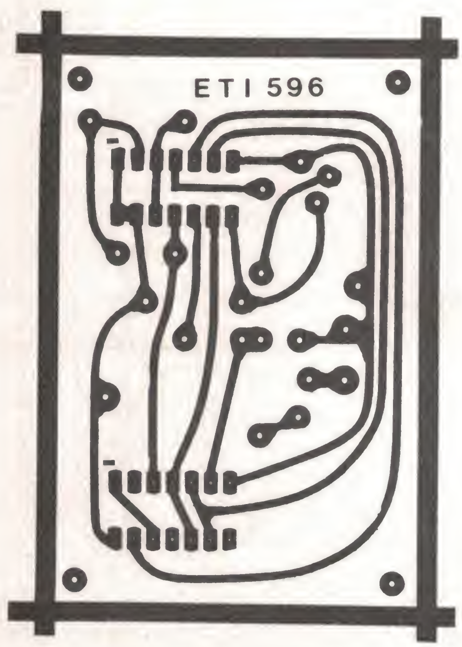


Component overlay.





ICs



EXCESS STOCK CLEARANCE SALE

AT UNREPEATABLE PRICES

PRICES CURRENT ONLY UNTIL 30th NOVEMBER. FULL SPEC. PRIME COMPONENTS. SALES TAX INCLUDED.

MINIMUM ORDER $20.00 — MINIMUM P & P $2.00.

AD149	1.20
AD161	1.20
AD162	1.20
BC107	18
BC108	18
BC108C	25
BC109	18
BC109C	25
BC177	18
BC177B	35
BC178	18
BC179	18
BC182B	12
BC212L	12
BC214L	14
BC286	09
BC287	09
BC317	12
BC318	12
BC319	12
BC327	15
BC337	15
BC338	15
BC546	12
BC547	09
BC548	09
BC549	09
BC556	12
BC557	10
BC558	10
BC558B	12
BC559	10
BC639	25
BC640	25
BCY71	35
BCY72	35
BD131	35
BD139	50
BD140	50
BD234	60
BD262	80
BD263	80
BD648	1.00
BDV64B	2.00
BDV65B	2.00
BF115	35
BF167	50
BF173	50
BF180	45
BF338	50
BF494	12
BFR84	80
BFW10	80
BFX84	45
BFY50	45
BFY90	80
BU126	2.00
BUX80	5.50
FPT100	60
MJ802	2.50
MJ2955	60
MJ4502	2.50
MJ15003	2.90
MJ15004	2.90
MJE350	1.40
MJE2955	80
MPF131	80
MPS3565	10
MPS3638	10
MPSA05	20
MPSA12	30
MPSA14	25
MPSA55	20
MPSA56	20
MPSA92	30
MPSA93	30
PN2222A	20
PN2907A	30
PN3565	10
PN3566	10
PN3569	10
PN3567	10
PN3568	10
PN3638A	10
PN3541	10
PN3542	10
PN3644	12
PN3645	12
PN3646	12
PN3564	12
PN3693	15
PN3694	15
PN4121	20
PN4248	12
PN4250	15
PN4355	15
TIP2955	90
TIP3055	60
TT800	70
2N697	30
2N918	35
2N2219	30
2N2219A	35
2N2222A	20
2N2368	15
2N2369A	35
2N2484	30
2N2646	60
2N2904	30
2N2905	30
2N2905A	30
2N2906A	30
2N301	2.00
2N3055	60
2N3054	95
2N3053	40
2N3300	45
2N3302	40
2N3638	15
2N3642	15
2N3702	10
2N3703	15
2N3704	15
2N3740	90
2N3819	25
2N3904	15
2N3906	10
2N4030	60
2N4032	50
2N4033	60
2N4036	70
2N4037	70
2N4124	15
2N4126	25
2N4231	70
2N4234	1.10
2N4235	90
2N4870	70
2N5086	15
2N5087	15
2N5087	15
2N5088	15
2N5089	15
2N5401	60
2N5458	30
2N5459	30
2N5461	50
2N5462	50
2N5485	35
2N5550	50
2N5871	90
2N5873	90
2N5874	95
2N6027	80
2N6124	60
2N6126	70
2N6129	70
2N6130	70
2N6132	85

TTL-7400

7401	15
7402	15
7403	15
7404	15
7405	20
7406	40
7407	30
7408	15
7409	15
7410	15
7412	30
7413	40
7414	40
7416	40
7417	45
7420	15
7421	20
7422	25
7425	40
7426	30
7427	30
7430	20
7432	20
7437	30
7438	30
7440	20
7441	1.50
7442	50
7447	80
7448	60
7450	20
7451	20
7453	20
7454	20
7460	20
7470	30
7472	35
7473	35
7474	20
7475	30
7476	30
7480	60
7483	80
7485	80
7486	40
7489	1.50
7490	30
7491	60
7492	50
7474	60
7495	60
7496	60
74100	1.00
74107	40
74121	40
74123	50
74132	80
74145	80
74150	80
74151	80
74153	80
74154	80
74157	80
74160	95
74165	95
74172	80
74173	1.50
74175	80
74180	80
74192	95
74193	95
74176	80
74367	60

74LS

74LS00	20
74LS01	20
74LS02	20
74LS03	20
74LS04	30
74LS05	35
74LS08	20
74LS09	20
74LS10	20
74LS11	40
74LS12	20
74LS14	50
74LS15	50
74LS16	40
74LS20	20
74LS21	25
74LS27	20
74LS28	25
74LS30	20
74LS32	20
74LS37	25
74LS38	25
74LS40	20
74LS42	30
74LS47	80
74LS73	40
74LS74	30
74LS75	30
74LS78	50
74LS85	80
74LS86	40
74LS90	40
74LS92	60
74LS93	55
74LS95	60
74LS107	40
74LS109	30
74LS113	30
74LS114	50
74LS123	90
74LS125	40
74LS133	20
74LS138	60
74LS151	60
74LS155	40
74LS157	40
74LS160	40
74LS163	40
74LS164	80
74LS163	80
74LS169	95
74LS174	40
74LS175	50
74LS190	90
74LS191	80
74LS192	80
74LS193	80
74LS194	70
74LS195	60
74LS196	90
74LS197	90
74LS221	80
74LS247	95
74LS251	50
74LS253	50
74LS257	40
74LS259	1.90
74LS279	60
74LS290	80
74LS365	50
74LS366	50
74LS367	60
74LS368	40
74LS373	1.40
74S02	50
74S74	80

CMOS

4000	15
4001	30
4002	30
4007	30
4008	80
4009	50
4011	40
4012	20
4013	40
4014	80
4015	70
4016	40
4017	80
4018	80
4019	95
4020	80
4021	80
4022	80
4023	20
4024	60
4025	20
4027	40
4028	60
4029	90
4030	50
4035	80
4040	80
4042	80
4043	60
4044	60
4046	1.50
4047	95
4049	60
4050	50
4051	80
4052	80
5053	80
4060	90
4066	60
4067	9.00
4069	20
4068	30
4070	50
4071	20
4072	20
4076	1.00
4077	20
4078	40
4081	20
4082	20
4093	40
40106	50
40194	1.20
4441	60
4502	80
4506	40
4510	90
4511	80
4518	95
4520	80
4528	80
4543	1.50
4553	4.95
4555	60
4581	2.50
4582	80
4584	60
4585	1.60
40014	50
40097	60
40098	80

74C Series

74C02	25
74C08	25
74C10	25
74C20	25
74C48	1.50
74C73	70
74C76	60
74C90	80
74C93	80
74C175	95
74C86	60
74C192	95
74C915	95
74C935	7.50
74C926	4.50

DISPLAYS

FND500	1.00
DL747	2.50
MAN72A	90

BRIDGE RECT.

400V/10A	2.95
VM48	95
W02	60

VOLT. REGS.

309K	1.20
317T	1.50
317K	2.50
317K	2.50
723N14	40
723 Can	75
7805	70
7805K	1.50
7812	70
7812K	1.50
7815	70
7818	70
7824	70
78H05	7.50
78P05	8.0
78L05	30
78L09	30
78L12	30
78L15	30
78L18	30
78L24	30
78CB	1.80
7905	1.20
7905K	2.20
7906	1.20
7908	1.20
7912	1.20
7912K	2.20
7915	1.20
7918	1.20
7924	1.20
79HGKC	7.50
79L03	50
79L05	50
79L12	50
79L15	50
79L18	50
79L24	50
79MGT2C	1.20
78MGT2C	1.20

DIODES

A14P	50
AAY30	30
BA102	50
BA244	15
BAW62	08
BP104	1.90
BR100	20
BYX10	50
BYX71-350	90
HP2800	1.90
OA90	12
OA91	12
OA95	12
IN3493	95
IN3493R	95
IN4002	06
IN4004	06
IN4007	12
IN914	04
IN5060	35
IN5404	30
IN5408	60
P600G	70

LINEAR

307	50
308	80
310	1.80
311	50
318	2.00
319	2.50
324	60
331	2.95
339	60
377	1.80
378	2.95
380N14	95
381	1.80
381AN	2.50
382	1.40
383	2.00
387	1.20
388	90
555	25
556	80
709	50
710	50
711	50
725	2.95
733	2.50
739	1.95
741	20
748	60
1458	50
1558	1.20
2917N8	1.80
2917N14	2.20
3089	3.00
3360P	95
3403	1.20
3900	60
3905	1.20
3909	80
3911	1.20
3916	3.00
5534N	1.60
7932	2.50
7555	1.20
13600	1.50
CA3046	1.00
CA3080	1.20
CA3086	50
CA3140	80
CA3302	50
CA3401	50
LM386N1	80
LM386N2	90
LF353	1.00
LF356	80
RC4136	1.00
RC4151	1.20
SAK140	1.50
TBA641	1.50
TL080	80
TL081	50
UAF771	40
UAF772	70
UAF774	1.20
XR082	90
XR084	1.50
XR8038	3.50
TCA220	2.00

SCR. —

C106E, 500V 4A, TO126	45

ZENER DIODES

½ Watt	10
1 Watt	18
2½ Watt	50
5 Watt	90
62V, 5 Watt	1.00
75V, 1½W	20

STATIC RAMS

2102	90
2102A4	1.00
2114N	3.00
2114-3	5.00

CPU

6800P	6.00
6810P	3.00
6850	4.00
8085	12.00
Z80P10	8.00
Z80CTC	8.00
Z80CPU	8.00

PROMS

2708	4.00
2716	10.00
93448	12.00

DYNAMIC RAM

4114	5.00

INTERFACE

1488	50
9368	1.00
9528	2.50
8T24	1.50
8T26	1.50
8T28	1.50
81LS95	1.50
81LS97	1.50

TRIGGER DIODES

BR100	20
ST2	40

TANTALUMS

.1, .22, .33, .47, .68/35V	20
1u, 2u2, 1u5, 3u3, 4u7, 6u8 @ 35V all	25
10uF 35V	40
15uF 35V	40
22uF 35V	80
6uF 25V	20
10uF 25V	50
4uF 16V	20
22uF 16V	25
47uF 16V	90
150uF 16V	2.00
33uf 10V	40
100uF 10V	80
47uF 6.3V	30
150uF 6.3V	40

ELECTRO RP

2500/35V	1.00
2500/63V	2.50
2500/80V	2.50
5600/40V	3.00
10,000/40V	4.50

CERAMICS 63/630V

1pF through to .0047uF all	04

TASMAN ELECTRONICS

12 VICTORIA STREET, COBURG, VICTORIA, 3058

PHONE: (03) 354 5062

Information

If you're really into electronics....

If you're 'investing' in electronics knowledge, then the ETI Collection represents probably the best 'portfolio' you can assemble. The electronics hobbyist, experimenter, dedicated project builder, technician or engineer will find a wealth of useful, informative and practical information between the covers of these books. No matter what your interest — you'll find something of value in the ETI Collection.

TOP PROJECTS Vols. 5, 6 and 7

A total of more than 60 projects is included in this series! Each book includes over 20 popular projects from ETI; the following samples will indicate what you'll find. **Vol.5** — howl-round stabiliser, graphic equaliser, compressor/expander, ultrasonic switch, CB power supply, GSR monitor, transistor-assisted ignition, skeet game, house alarm. **Vol.6** — Series 4000 stereo amp, Series 4000 MC preamp, Series 4000 4-way loudspeaker, 300 W power amp, fuzz/sustain unit, aircraft band converter, linear scale ohmmeter, electromyogram, disco strobe. **Vol.7** — two metal detectors, LED tacho, 140 W valve amp, Series 3000 compact stereo, AM tuner, general purpose power supply, pH meter, geiger counter, digital clock with huge display, laser.

Vol.5 $3.00, Vol.6 $3.95, Vol.7 $3.95 — all plus 90 cents post & handling

PROJECT ELECTRONICS

Revised, 4th edition. This book was specially designed to meet the needs of newcomers to electronics, and in particular school students following the three-segment industrial arts syllabus in electronics. It has been a runaway success since the first edition. Twenty six projects, many available as kits, are included, along with tips on construction, troubleshooting and component identification. Amongst the inexpensive projects, you'll find: a continuity tester, a two-tone doorbell, basic amplifier, AM tuner, two crystal sets, LED dice, train controller, etc.

$4.75 plus 90 cents post & handling

SIMPLE PROJECTS Vol.2.

An ideal companion to Project Electronics. Over 20 projects are crammed between the covers of this popular book. You'll find these, for example: telephone bell extender, photographic strobe, transistor tester, touch switch, courtesy light extender, code practice oscillator, drill speed controller, mini organ, etc. Also included is a deal of useful information on component codes and markings, transistor connections, etc.

$2.95 plus 90 cents post & handling

ELECTRONICS IT'S EASY — New two-volume set!

Basic reference texts for all electronics enthusiasts, hobbyists, technicians, etc. Used as text books by many colleges, TAFEs, etc. Written by Dr Peter Sydenham in an easy-to-read style, this two-volume set is copiously illustrated and includes practical things for you to do to aid learning. **Vol.1** covers basic concepts, components and analogue techniques. **Vol.2** covers digital techniques, instruments and the control of power. Originally published as a three-volume set, the entire manuscript was revised and updated for publication in this format.

$5.95 each plus $1.10 post & handling

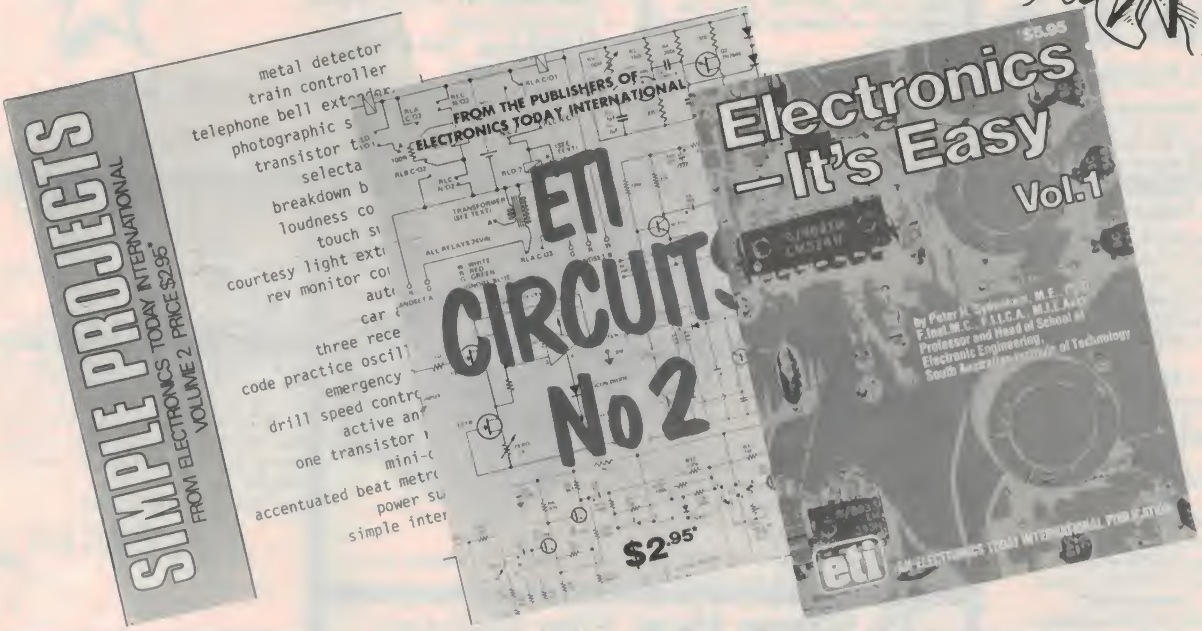
CIRCUIT TECHNIQUES Vol.1.

A very recent addition to the Collection, this book is subtitled "The how, what, which, where, why and how much anthology of electronic components, circuits and techniques". Which explains a lot! In its 148 pages are 16 articles: Lab Notes, Practical Guides and Cookbooks covering a wide variety of electronic circuitry and techniques, from op-amps to filters, from potcore inductor design to 555 timer applications, from VFETs to MOSFETs, voltage regulators to crystal oscillators, LEDs, zeners, Schmitt triggers — it's all there. A most valuable reference work.

$4.75 plus 90 cents post & handling

Explosion!

you'll be into the ETI Collection



HOW TO BUILD GOLD & TREASURE DETECTORS

There's gold in them there hills, and old coins and trinkets, etc, etc! You can join the fascinating hobby of prospecting and treasure hunting by building your own detectors. This book contains seven detector projects: ETI-1500 Discriminating Metal Detector, ETI-561 Simple Metal Detector, ETI-549 Induction Balance Metal Detector, ETI-566 Deep Seeking Metal Locator, ETI-562 Geiger Counter, ETI-213 Revealer and an Earth Resistivity Meter. Also included are articles on how metal detectors work and how to use them, exploration techniques and where to buy ready-made as well as detector kits.

$3.95 plus 90 cents post & handling

TEST GEAR Vols. 1 and 2

Having the right test equipment will help you tackle more projects and more complex projects with confidence. With test equipment you can fault-find, troubleshoot and analyse the projects you build or experiment with and gain a greater understanding of the circuitry and techniques employed at the same time. You can save money too.

Test Gear Vol.1 includes projects for an audio level meter, an impedance meter, a temperature meter, an audio signal generator, a simple frequency counter, a phase meter and much more in its 116 pages.

Vol.2 includes: a sound level meter, an audio spectrum analyser, audio power meter, 1 GHz counter/timer, true RMS voltmeter, digital temperature meter, capacitance meter, RF signal generator, SWR/power meter, logic trigger, logic test probe, dc power supply — and more, packed into 132 pages.

Vol.1 $3.00 plus 90 cents post & handling
Vol.2 $3.95 plus 90 cents post & handling

CIRCUITS No.1, No.2, No.3

Each of these books is a giant compendium of over 200 circuits culled from the Ideas For Experimenters pages of ETI's Australian and British editions — many have not been previously published in Australia. Each is an invaluable reference of circuits and ideas for the hobbyist and experimenter. Each book is divided into chapters under headings such as: Alarms, Amplifiers, Automobile, Conversion Tables, Crossovers, Crystal Oscillators, Detectors, Digital, Filters, Music Electronics, Timers, RF, Test and Measurement, etc.

$2.95 each plus 90 cents post & handling

HOW TO ORDER: If you cannot find the book or books you want at your local newsagent or electronics supplier, you may order direct from ETI. Fill in the coupon, enclose a cheque or money order (don't forget to include postage) and send it to:

ETI Collection Electronics Today Magazine
15 Boundary St Rushcutters Bay NSW 2011

Please send me (put x in box)

- ☐ Test Gear Vol.1
- ☐ Test Gear Vol.2
- ☐ Top Projects Vol.5
- ☐ Top Projects Vol.6
- ☐ Top Projects Vol.7
- ☐ Circuits No.1
- ☐ Circuits No.2
- ☐ Circuits No.3
- ☐ Electronics It's Easy Vol.1
- ☐ Electronics It's Easy Vol.2
- ☐ Project Electronics
- ☐ Gold & Treasure Detectors
- ☐ Simple Projects Vol.2
- ☐ Circuit Techniques Vol.1

Name ....

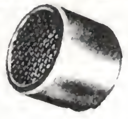
Address ....

.... **Postcode** ....

I enclose $ .... **(inc. p. & h.).**

EVEN MORE GREAT SPECIALS FROM JAYCAR!

ELECTRET INSERT



ONLY $1.49

SAVE NEARLY 40%

Electret inserts back on special!! For those who missed out in July. These are normally $2.45 each. Grab them now!!!

ETI 473 Moving Coil Preamp Kit Sellout!!

This is the original ETI design. Kit includes quality PRE-PUNCHED power supply and amp boxes and beautifully anodised and silk-screened front panels.
The Jaycar kit of the 473 normally sells for $95. We have only a few (and we mean that) left at only

$74.50 comp.
SAVE OVER $20!!!

8 CHANNEL MIXER KIT

We are completing work on our new 8-channel stereo mixer

A few specs:
- 19" rack or console mount
- Balanced inputs and 2 outputs
- Equalisation on each input
- Uses latest NE5534 Op amps
- Very low noise
- Effects (e.g. "Echo" etc)
- Foldback send
- Switchable line and mic. level inputs with separate attenuation control

Don't buy a mixer until you have seen this one!
Send SAE for more information. P.O.A.

Audio Adaptor Sellout.

We honestly think that some of our audio adaptors are so USELESS that we can't even imagine a use for them! They are very high quality solid metal types. If you want 'em — grab 'em! Maybe your imagination is better than ours!!

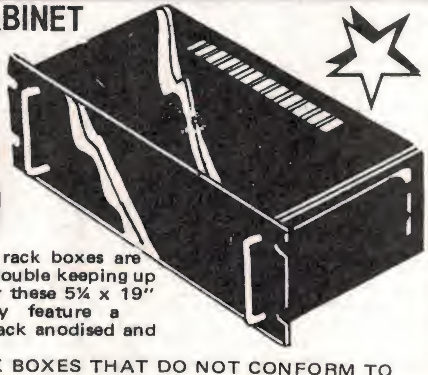
DESCRIPTION

6.5mm plug to 3.5mm plug (or vice-versa)
RCA socket to screw on microphone (or vice-versa)
6.5mm socket to screw on microphone (or vice versa)
6.5mm plug to 6.5mm plug (incredible but true)
6.5mm plug to RCA plug
6.5mm socket to 6.5mm socket (unbelievable!)
6.5mm socket to 3.5mm socket
RCA socket to RCA socket (could be handy)
3.5mm plug to 3.5mm plug (an ABSOLUTE must)
3.5mm plug to RCA plug
3.5mm socket to 3.5mm socket
RCA plug to RCA plug
3.5mm socket to 2.5mm plug
3.5mm socket to screw mic connector
No need to rush in folks, we have zillions of them.

ONLY 40c each

30c in mixed lots over 10

19" RACK CABINET



* * * * *

$45

19" black anodised rack boxes are back! We have had trouble keeping up with the demand for these 5¼ x 19" rack cabinets. They feature a magnificent 3mm black anodised and linished front panel.
BEWARE OF RACK BOXES THAT DO NOT CONFORM TO STANDARD RACK DIMENSIONS!!!!

AUDIO AMPLIFIER IC's SLASHED!!

TYPE	POWER	NORMALLY	THIS MONTH
TAA611B	2W	$2.50	0.50c
TBA810	6.5W	$4.50	0.95c
TBA651	AM Tuner IF	$6.50	0.50c

FREE DATA SHEET WITH EACH UNIT!

CERMET Trimmers in stock

Jaycar now stock high-quality Cermet trimpots. T.C. 100 ppm values from 100 ohms to 100K. 5mm lead spacing. Neat, tiny & rugged! Old fashioned carbon trimmers are a very common problem in circuits — specially amps.
Why not upgrade to Cermet?

only 50¢ ea.

1% 50ppm Metal Film Resistors

We stock the E-24 SERIES (i.e. 24 values per decade — not just 12 like everyone else). The Jaycar Metal-Film resistor is a very high quality Mil-Spec style (RN-60) of part (MIL-R-10509F)
Why not upgrade the reliability and performance (i.e. much lower "noise") for what amounts to modest cost?
Price: 1—99 ONLY 8c each — 100+ ONLY 6c each

THIS MONTH'S SNIP

A 250 GRAM roll of solder for the price of a 200 GRAM roll.
ONLY $4.95 0.8mm
Hey! That's 20% more for no extra cost!!

POST AND PACKING

$5 — $9.99		$1.00
$10 — $24.99	$100 up	$2.00
$25 — $49.99	$5.50	$3.00
$50 — $99.99		$4.00

Guitar Phaser Kit

Get great Phasing Effects from your Guitar or Synthesiser (or anything) at a fraction of the cost of commercial units. Easy to construct, this really effective Phaser gives a truly professional sound.
Based on Aug. '81 "hobby Electronics"
ONLY $26.50 including all parts

ONLY $26.50

ARLEC SUPER SWITCH

SUPER XXXX SPECIAL!!
NORMALLY $23.50
NOVEMBER ONLY $17.50
BE QUICK

ONLY $17.50

* * AT LAST * *

programmable master rhythm generator

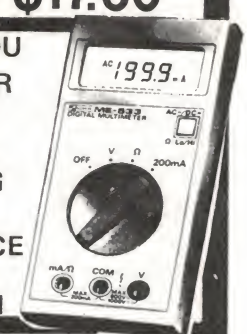
FULLY IMPORTED

This project was originally described in the UK publication "Practical Electronics". We have fully imported "Clef" kit
This attractive kit is presented in an attractive metal cabinet with silkscreened front panel.
The Master Rhythm can be programmed (in RAM) to play back:
— 24 Rhythm patterns — 8 parallel tracks — 12 instruments
It is also capable of sequence operation — the ULTIMATE UNIT

complete **$199** LOW POWER BATTERY DRIVEN

SEND SAE FOR DESCRIPTIVE LEAFLET

HAVE YOU SEEN OUR $49.95 AUTO RANGING DMM?? IT'S A PRICE BREAK THROUGH



Jaycar

NOTE! NEW SHOP HOURS
Mon - Sat 9am — 5.30pm
Sun - 10am — 2pm
Open Thursday night until 8pm.

380 Sussex St Sydney 2000
Ph. 2646688 Telex 72293
Mail Orders To: Box K-39 Haymarket 2000

DON'T FORGET OUR EA/ETI BELOW COST OFFER SEE OUR OCT. AD OR 'PHONE.

Project 158

Test meter measures resistance from 100 ohms down to 0.005 ohms

At some time or another, every practical electronics hobbyist will need to measure a low-value resistance that the ordinary multimeter can't cope with. This project, which has applications in many situations, solves this problem.

Design: **Ray Marston**
Development: **Simon Campbell**

THERE COMES a time in the life of every person involved in electronics in a practical way when the need to measure a resistance outside the range of common multimeters arises. What do you do? Some squint at the scale of their analogue multimeter and guess that the needle, close as it is to the end of the scale, is somewhere in 'the ballpark'. Others stare at the LCD display of their digital multimeter and despair as it reads "00.2 ... woops, 00.3 ... um, 00.2" etc. At this stage you can resort to a power supply to drive some current through the resistance to be measured and use your multimeter to measure the voltage drop across it. If you can read 1 V on your multimeter with sensible accuracy you'll need to drive two amps through a half ohm resistance. And that's not a good idea for a transformer winding rated at 200 mA, for example.

This project solves the difficulties generally experienced when you try to measure low value resistances. It has applications in many situations. When paralleling power transistors or three-terminal voltage regulators, for example, 'ballast' resistors are required so that each device in the circuit shares the load current equitably. These ballast resistors generally have values much less than one ohm, sometimes less than one-tenth of an ohm (0.1 ohm or 0R1). You can make a rough estimate of the length of copper wire of a particular gauge necessary to make a resistance of the desired value, simply from the published ohms/metre data on the wire gauge, but several pieces of wire cut to the same length from the same reel will not be the same resistance, and the actual resistance may be 20% or more different from the value required, owing to variations in the composition of the wire, diameter, etc. With our Low Ohms Meter, you can cut them to the value required and be assured of the result.

Other applications are: measuring the resistance of transformer windings, measuring the resistance of cable joints, measuring the resistance of tracks on printed circuit boards, etc.

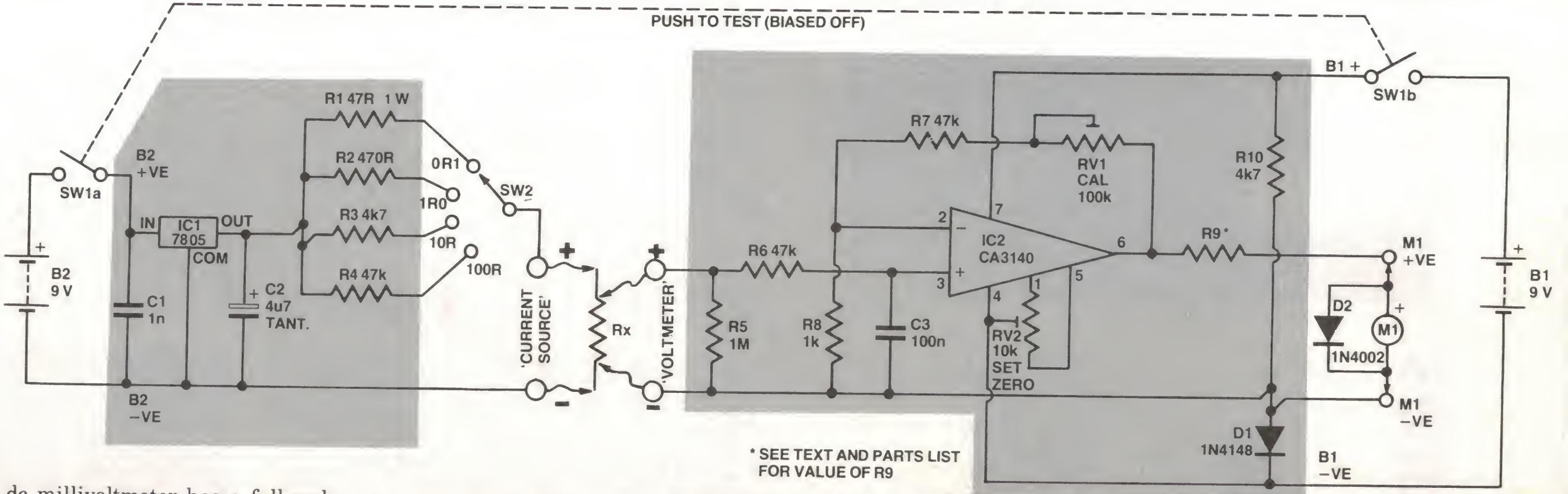
SPECIFICATIONS — ETI 158

Ranges (full-scale):	100R, 10R, 1R0, 0R1
Resolution:	0.05 of full-scale reading (0.005 ohms on 0R1 range)
Accuracy:	2.5% of full-scale reading or better (depends on meter used)
Maximum test current:	100 mA (approx.) (0R1 range)
Minimum test current:	100 uA (approx.) (100R range)

Design

The instrument consists of a multi-range current source and a dc millivoltmeter. The measuring method is known as a 'four-terminal' technique and it has the advantage of eliminating the effect of the leads connecting the instrument to the resistance to be measured. The current source provides a predetermined constant current that is 'driven' through the resistance to be measured. The voltage drop across the unknown resistance is then measured with a high input impedance dc millivoltmeter. The meter reading is directly proportional to the resistance being measured. This gives a linear scale, which is an advantage. The maximum current supplied by the current source is about 100 mA (only on the 0R1 range), which is quite safe in the majority of circumstances encountered. ▶

Project 158 — low ohms meter



* SEE TEXT AND PARTS LIST FOR VALUE OF R9

The dc millivoltmeter has a full-scale sensitivity of 10 mV. The current source provides a current on each range such that 10 mV is developed across an unknown resistance of the maximum value in each range. This four-terminal technique is widely used in precision measurement applications.

How does the instrument ignore the effect of the resistance of the connecting leads? Well, let us examine the worst case — say we are attempting to measure a resistance of around one-tenth ohm. The range switch (SW2) will be switched to '0R1'. This selects R1 to limit the maximum current to be supplied from the voltage regulator IC1, which provides 5 V. Now, if each lead from current source terminals to R_x has a resistance of half an ohm, a total resistance of one ohm will be connected in series with R_x. If R_x is one-tenth of an ohm (0.1 ohm or 0R1), then the total resistance placed across the current source terminals will be 1.1 ohms. As this is in series with R1, the current now flowing through R1, the leads and R_x will be given by:

HOW IT WORKS — ETI 158

The unit contains two separate circuits — a constant current source and a dc millivoltmeter. The constant current source drives a suitable current through the unknown resistance (R_x). The current can be selected by means of a switch (SW2, the 'range' switch). The consequent voltage drop across the unknown resistance can then be measured with the dc millivoltmeter. As the resistance of R_x is directly proportional to the voltage drop across it, and the current driven through it is known to be a constant, the meter scale may be calibrated directly in ohms (or fractions of an ohm).

The constant current source is quite simple and comprises B2 (9 V), IC1, R1 to R4, SW2 and associated components to the left of R_x in the circuit diagram. IC1 is a 7805 three-terminal, 5 V positive regulator. Capacitors C1 and C2 provide high frequency stability. Resistors R1 to R4, selected by SW2, set the current that flows in the unknown resistance, R_x. When the '0R1' range is selected, the current (limited by R1) will be around 100 mA. When the '1R0' range is selected, R2 will limit the current to around 10 mA ... and so on, through the ranges. Now, on each range, the value of the unknown resistance, R_x, will be very much lower than the value of the current limiting resistor (R1, R2 ... etc), by a ratio of around 500 to 1. The voltage drop across R_x will also be much, much lower than the output of IC1. Consequently, the test current from the current source is virtually independent of both lead resistance and the unknown resistance. On the '0R1' range, a total lead resistance of one ohm between the 'current source' terminals and the resistance being measured will only introduce an error of 2%. On the '100R' range, the same lead resistance will introduce an error of only 0.002%. The accuracy of the instrument is primarily determined by the tolerances of R1 to R4 and the meter accuracy.

The dc millivoltmeter is based on a CA3140 FET input op-amp. This IC has the advantage that it will respond accurately to dc inputs right down to 0 V. The voltmeter terminals are connected to the unknown resistance so that the meter circuit can indicate the voltage drop across the unknown resistance produced by the current source. The voltmeter circuit has a very high input impedance so that the current flowing into the voltmeter input resistance is very much less than the current flowing through R_x. The voltmeter input impedance is principally determined by R5, a 1M resistor. IC2 amplifies the voltage drop across R_x, its output driving a meter. The gain of IC2 is proportional to the ratio of RV1 plus R7 to R8 and is set to about 100, so that a voltage drop of 10 mV across R_x will produce an output between pin 6 of IC2 and the 'M1 −VE' terminal of 1 V. Thus, whatever full-scale deflection value meter is used, 1 mA or 100 uA, R9 is selected so that the meter actually reads 1 V full-scale deflection. In fact, M1 and R9 may be dispensed with and you could use a multimeter set to the 1 V scale. Diode D2, mounted across the meter terminals, prevents damage to the meter if the unit is incorrectly ranged so as to produce an output from IC2 of greater than 1 V. Being a silicon diode it will conduct when the voltage across the meter terminals rises to about 0.6 V.

So that any dc offset in IC2 can be compensated for, a zero set adjustment is provided. In order to set this accurately, the output of IC2 needs to be driven slightly negative and a small negative potential is developed across a forward-biased diode, D1. Current through R10 biases this diode on.

To accurately set the full-scale reading of the dc millivoltmeter, the gain of IC2 is adjusted by RV1 with a known accurate resistance placed in circuit.

Capacitor C3 bypasses hum and noise at the input of IC2, picked up by the leads from the 'voltmeter' terminals connecting to R_x.

As B2 has to supply up to 100 mA of current, a large-capacity battery is suggested. The dc millivoltmeter circuit only draws a few milliamps and thus a standard 9 V transistor radio battery is all that is required.

$$\frac{5}{47 + 1 + 0.1} = \frac{5}{48.1}$$
$$= 104\text{ mA}$$

Now, if the lead resistance were zero, the current flowing through R_x will be given by:

$$\frac{5}{47 + 0.1} = 106\text{ mA}$$

Thus a lead resistance of one ohm between the current source terminals and the resistance being measured will introduce a percentage error of:

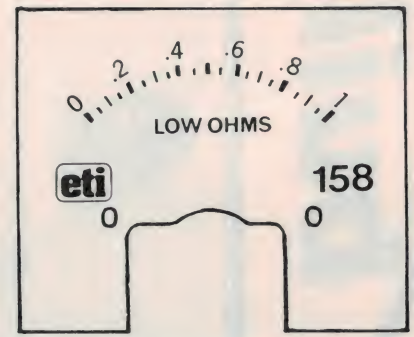
$$\left(\frac{106}{104} \times 100\right) - 100 = 1.9\%$$

Looking at it another way, the ratio of the current-limiting resistor selected by the range switch (R1, R2 ... etc) to the resistance of the connecting leads between the current source terminals and R_x is very high, and thus it is the current-limiting resistor which principally determines the current driven through R_x.

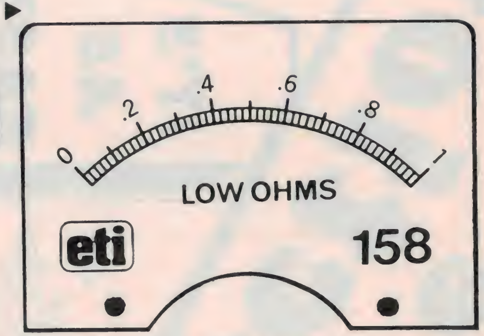
The dc millivoltmeter connects across the resistance being measured. It has an input impedance principally determined by R5, as IC2 is a CA3140 FET input op-amp with an input impedance specified as 1.5 Teraohms (10^{12} ohms!) In the worst case, when using the 100R current source range and measuring a 100 ohm resistor, the dc millivoltmeter input impedance will be 10 000 times larger than R_x and its effect will thus be insignificant. As the dc millivoltmeter is connected directly across the unknown resistance, and not across the current source terminals, the voltage drop across the leads from the current source terminals to the unknown resistance is ignored.

In practice, the accuracy of the instrument will be determined by the accuracy of the meter movement used. Most common, low-cost meter movements are 'Class 2.5' types with an accuracy of 2.5% of full-scale reading.

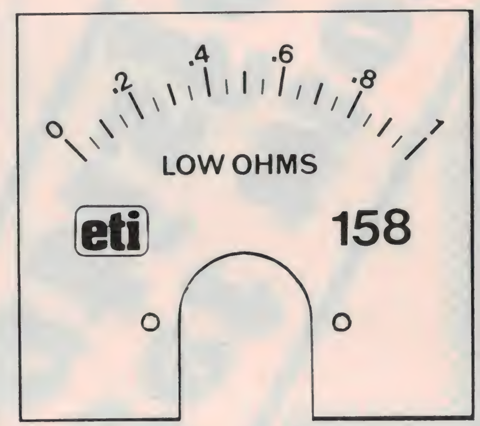
A variety of meters may be used. The common 1 mA movements are inexpensive and there are several models around. Alternatively, 500 uA or even ▶



Scale for the Minipa MU-45.

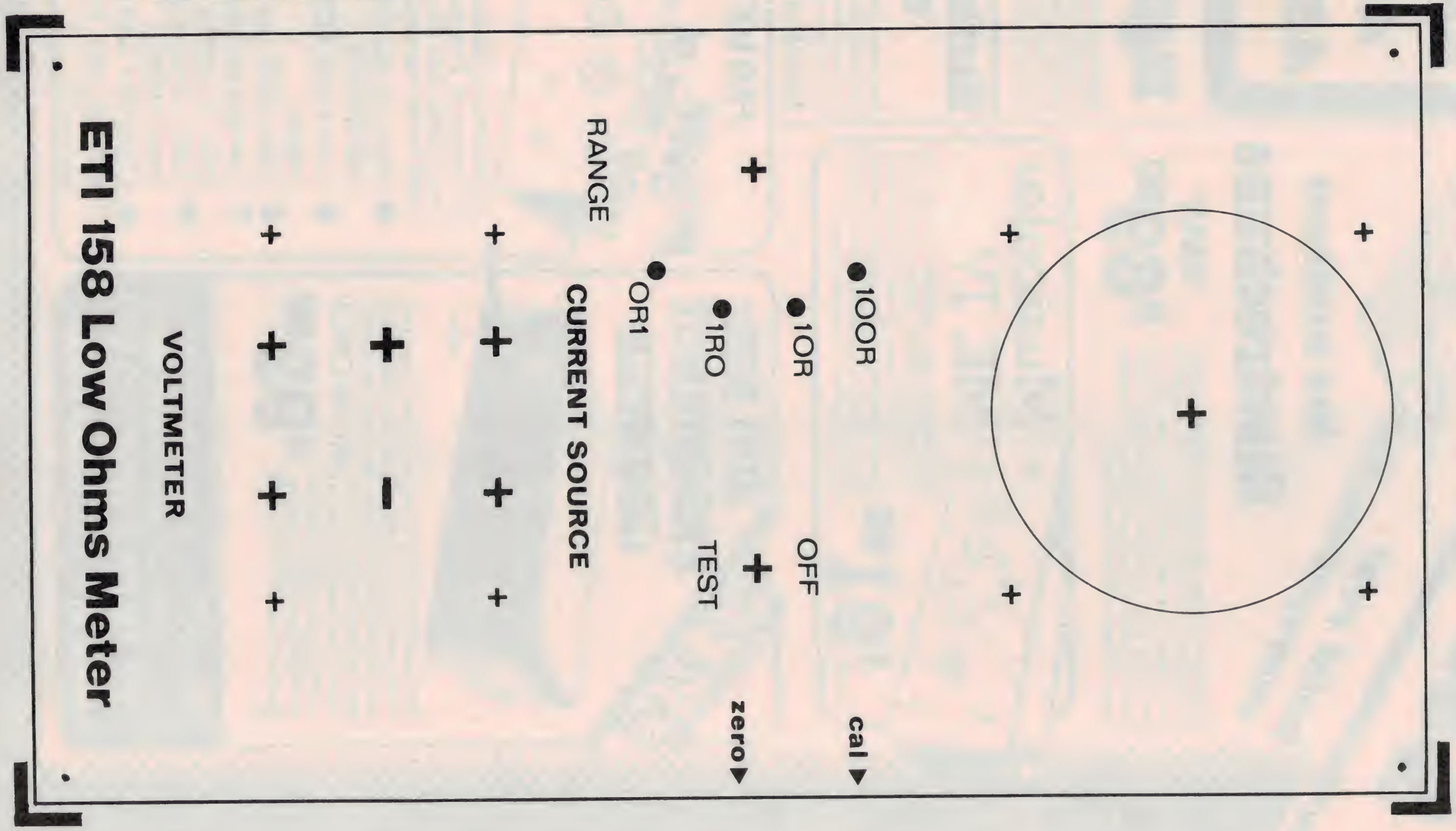


Scale for the SEW ST-65



Scale for the University TD66

Full size artwork for the front panel.



get more satisfaction build

IT'S AS EASY AS ABC!

Everything you need is supplied — parts, solder, even nuts and bolts. And most kits include detailed instruction manuals, making construction a breeze!

build your own synthesizer

K-3506

the brilliant Electrochune

A versatile keyless monophonic organ that uses the circuitry of a synthesizer! It has a variable attack/decay, tremolo & mixing control. Plus its own inbuilt amp & speaker with volume control. This touch sensitive keyboard, gives an incredible range of sounds that will amaze you.

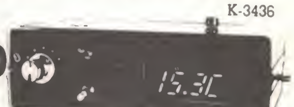
ONLY $69.90

Digital clock/thermometer

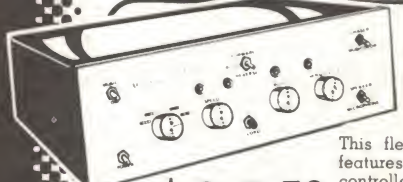
K-3436

Has Huge bright red digit display, 6 display modes. Time & temperature display, alarm & control for clock, radio, etc. 12/24 hr - C/F Battery back up facility.

$49.50



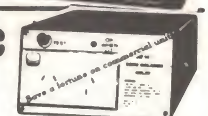
Musicolor MK IV



This flexible light controller has all the features of the MK.III, plus lots more! Has 4 controlled channels, a light chaser with 4 chase patterns & a reverse switch for startling effects. Add it to your stereo - just connect it to your speakers. Completely safe!

$91.50 K-3143

Earth leakage Electronic circuit protector



Senses any leakage to earth from mains appliance (eg. through your body) & shuts off power before it has a chance to ZAP you. Includes pre-wound coil. Should be in every hobbyists workshop - it could save your life! K-3315

$52.00

SAVE A FORTUNE ON COMMERCIAL UNITS!

SAVE $20 — 200 MHz FREQUENCY COUNTER

K-3437

This superb unit has a rugged drilled case with black marvi-plate cover and special silk screen printed perspex front panel. Readouts are rugged light emitting diodes for long trouble free service. Also has built-in quartz crystal time-base circuit for incredible accuracy. Operates from 12V DC or 240V AC.

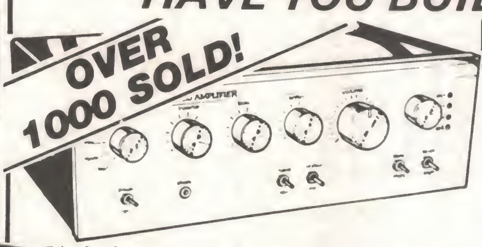
NOW ONLY $99.50

PLUS you get the Pre scaler IC to convert your counter to 200MHz **AT NO EXTRA COST!**

95H90 IC Cat. Z-5360 VALUE $19.50

HAVE YOU BUILT YOUR Playmaster MOSFET AMP?

OVER 1000 SOLD!



It's the lastest in the incredibly successful series of Playmaster amplifiers (over 10,000 Twin 25's & Forty/Forty's built!) but this one really has everything:

- State-of-the-art POWER MOSFETS!
- Low-noise FET input preamps!
- Over 50W per channel!
- Speaker switching plus loudness & muting controls!
- And a brand new professional styling!
- Complete with our famous step-by-step instruction manual!

includes professionally designed front panel.

ONLY $132.00 K-3515

TRANSFORMER SUPPLIED SEPARATELY (Cat. M-0152) $29.90

UPGRADE YOUR HI-FI SYSTEM NOW!

100 uA movements may be used. However, you'll find that different makes in the same sensitivity have different impedances. We used a University TD-66. These have a 100 ohm impedance in the 1 mA movement and a 2k impedance in the 100 uA movement. The Minipa meters in the MU-45 size have a 120 ohm impedance for the 1 mA movement, 1400 ohms for the 50 uA movement. The value of R9 needs to be chosen to suit the sensitivity of the meter movement used. The CAL adjustment takes care of the different meter impedances as the gain of IC2 is set to suit.

For a 1 mA movement with an impedance between 100 and about 300 ohms, R9 should be 820R 1% or 2%. For a 50 or 100 uA movement with an impedance of between 1k and about 3k, R9 should be 8k2 1% or 2%.

Construction

The electronics are contained on a small 50 x 100 mm printed circuit board and the major components are mounted on the front panel of a conveniently sized jiffy box. While we have chosen to mount the electronics on a printed circuit board, layout is not critical and they may be mounted on matrix board, Veroboard, Uniboard or whatever.

If you elect to build your unit in the same fashion as we did our prototype, then the best place to start is with the mechanical work. We dressed up our front panel with a Scotchcal overlay, the design of which is reproduced on page 57. You can use this to mark out the drill hole positions on the jiffy box front panel. Note that the holes for the meter are marked out for a University model TD-66 meter movement. You will have to mark out holes to suit the meter you have if you intend using another type. Centre punch the holes to be drilled and then drill them carefully. Sizes will vary depending on the particular components used so we haven't given any hole dimensions. Note that for the voltmeter and current source terminals we used spring-loaded speaker terminals which are conveniently colour-coded black (−ve) and red (+ve). We drilled holes behind the terminals where the solder connection to each protrudes through the panel — no need to cut slots.

Cutting the meter hole can be a hassle if you don't have a hole cutter. There are several ways to do it. One is to mark a circle on the panel just larger than the diameter of the hole required. Then, using a 3 mm or 4 mm diameter drill bit, cut a series of holes around this ring — each hole overlapping the last. The centre piece may then be pushed out and the edge of the hole cleaned up with a fine-cut half-moon file. Tedious, but it works. Another method again requires marking a hole just larger than that required and then drilling a large hole inside the circle, inserting a 'nibbling' tool and then cutting around the marked circle.

Having drilled the front panel, do a trial 'fit' of all the components that mount on it just to see that nothing needs to be adjusted or holes reamed out, etc.

If all is well, you can take the parts off the panel and then carefully stick the Scotchcal label to the panel and trim the edges. Next mount all the major components in place and orientate SW1 and SW2 so that their operation corresponds to the panel markings.

The pc board assembly may be tackled next. This is quite straightforward and the components may be assembled in any convenient order. Take care though with the orientation of IC1, IC2 and C2. Don't confuse R3 and R10. Note that R3 is a 1% or 2% metal film type whereas R10 is an ordinary 5% carbon type. Likewise, don't confuse R6 with either R4 or R7, as the former is an ordinary 5% carbon type and the latter two are metal film 1% or 2% types. Note that the two trimpots mount with their adjusting screws facing off the end of the pc board. Having completed the pc board, check it and then you can tackle the wiring from the board to the major components on the front panel.

Take care with the wiring to the voltmeter and current source terminals that you get the +ve and −ve connections the right way round. Note that diode D2 mounts on the meter terminals. Also make sure that you wire the meter the right way round. As a variety of switches are available to suit SW2 we have only shown a diagramatic wiring arrangement for this, as the pins may differ between different switch types. The enclosed type, such as those from C&K, have the pole marked 'A' and the switch position marked '1,2,3,4' and they should be wired to conform to the designations on the wiring diagram. The connections to the open type of rotary switch are readily figured out by examination.

Rear view of a C&K four-position switch showing the connections for SW2.

The only other item, or items, to watch concern the battery clip leads — make sure you connect them with the correct polarity.

Having got it all together, check your wiring and you're ready for a test flight. Plug in B1, and with nothing connected to the terminals, operate SW1 ('TEST'). Adjust the 'ZERO SET' trimpot to zero the meter.

Now, obtain a 100 ohm resistor — in fact, it is a good idea to buy a 100R 1% or 2% resistor for calibration use when you buy the rest of the components.

Plug in B2 and connect your resistor to the current source terminals. Take two leads with alligator clips on one end and connect the voltmeter terminals to the resistor — watch the polarity. Set the range switch to 100R and operate SW1. Now, adjust RV1 ('CAL') so that the meter reads full-scale deflection.

Now you're ready to roll, if all is well.

To permit adjustment of the CAL and ZERO trimpots with the project assembled in the case, we drilled two holes in the side of the case to permit access to the trimpot adjustors with a screwdriver. We located the hole positions by temporarily mounting the board in the case and marking the case on the outside where we judged the holes should be. Drill oversize holes and you can't go far wrong!

Assemble the pc board in the case, put the batteries in place and screw on the front panel. Repeat the zero procedure — but first adjust the meter movement mechanical zero, located at the bottom of the meter face. Then calibrate the unit on the 100R range using your 100R calibration resistor. Now you're calibrated and ready for work!

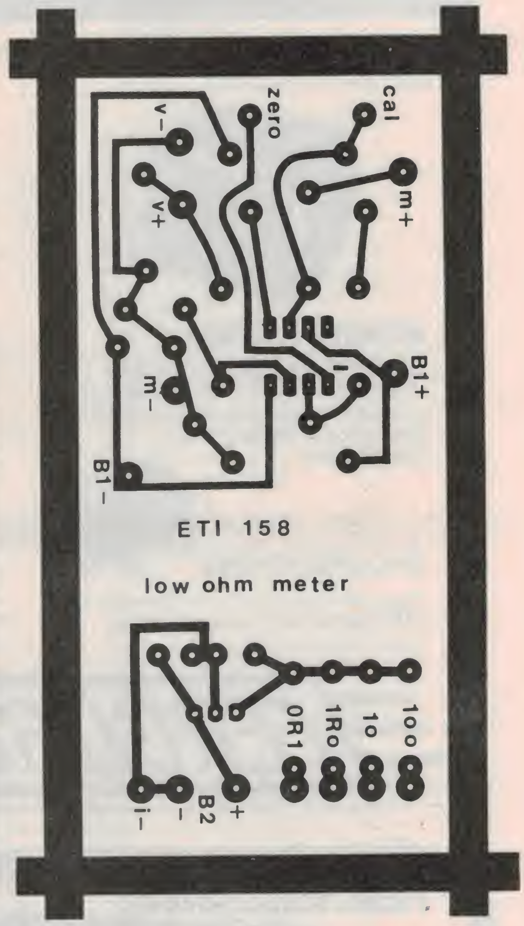
Using it

The 'TEST' switch, SW1, is a spring-return type, so that the measurement current supplied by the current source is only applied for the length of time it takes to make the measurement. This helps to prolong battery life in case you leave the unit turned on and ensures that in applications where the 100 mA maximum test current may cause component heating that it is only applied for a limited period.

In use, always connect the current

source to the unknown resistance with heavy leads that are as short as practicable. The actual connections may well have the greatest resistance, so when using the 0R1 range make sure you arrange good, solid connections to ensure the best accuracy. The voltmeter should be connected with flying leads with clips on the end — always attach the clips across the actual resistance being measured, not across the current source terminals or somewhere on the connecting leads.

To read off resistance, multiply the scale reading on the meter by the setting of the range switch. For example, if the meter reads 0.7 and the range switch is set to 1R0, the value of the resistance being measured is 0.7 ohms, or 0R7. ●



PARTS LIST ETI-158

Resistors

R1	47R/1 W, 1% or 2%
R2	470R/½W, 1% or 2%
R3	4k7/½W, 1% or 2%
R4, R7	47k/½W, 1% or 2%
R5	1M/½W, 5%
R6	47k/½W, 5%
R8	1k/½W, 1% or 2%
R9	820R, ½W, 1% or 2% (see text)
R10	4k7/½W, 5%
RV1	100k cermet multiturn horizontal trimpot
RV2	10k cermet multiturn horizontal trimpot

Capacitors

C1	1n ceramic
C2	4u7/16 V tant.
C3	100n greencap

Semiconductors

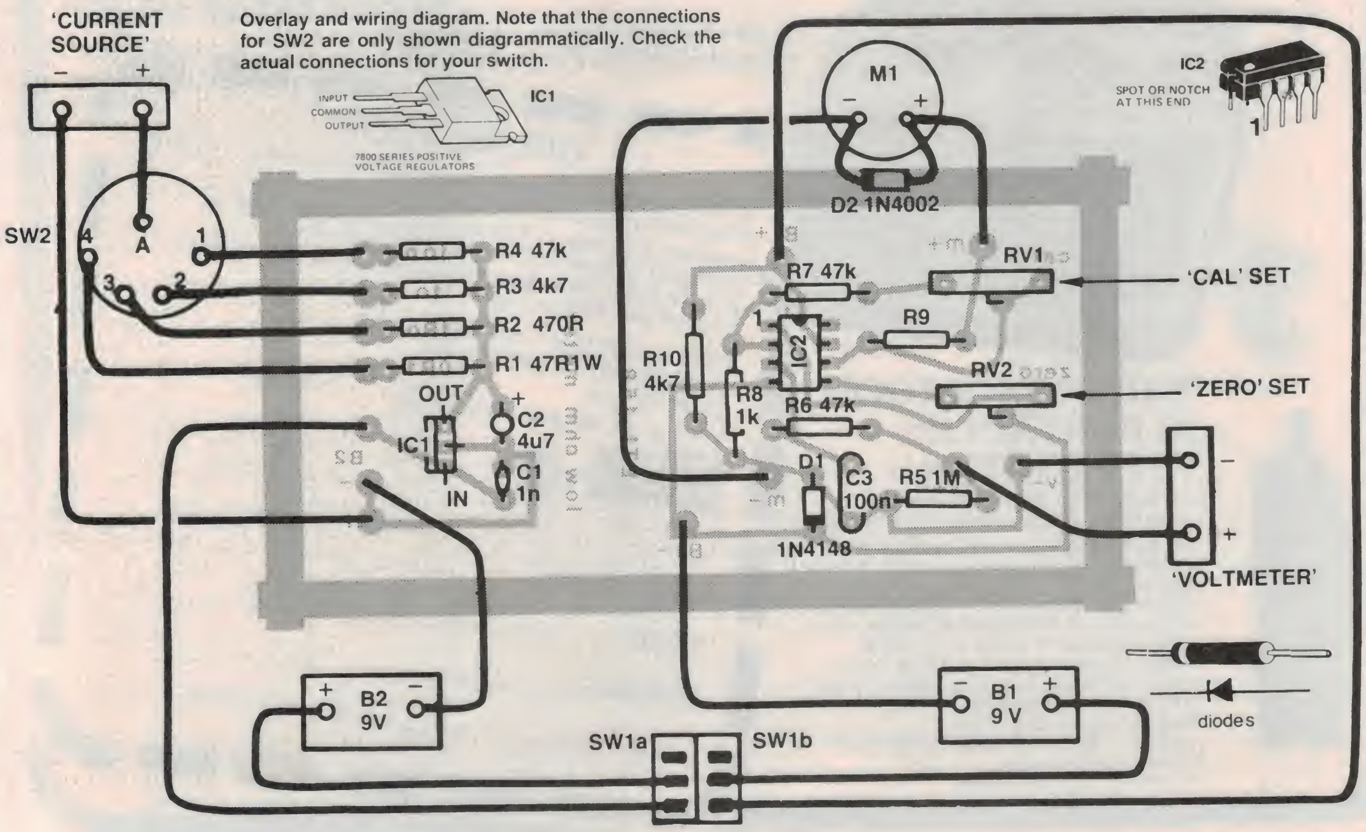
IC1	7805, LM340/T5 etc, 5 V reg.
IC2	CA3140
D1	1N914, 1N4148 etc.
D2	1N4001, EM401, 1N4002 or sim.

Miscellaneous

SW1	DPST spring-return toggle switch
SW2	single-pole, four-position rotary switch
B1	No.216 9 V battery
B2	No.276P 9 V battery
M1	TD66 meter 0-1 mA, 100 ohms internal resistance (see text)

ETI-158 pc board; zippy box No. H0102 196 x 113 x 60 mm or similar; Scotchcal front panel and meter scale; knobs; spring terminals; battery clips, etc.

Overlay and wiring diagram. Note that the connections for SW2 are only shown diagrammatically. Check the actual connections for your switch.



ELLISTRONICS

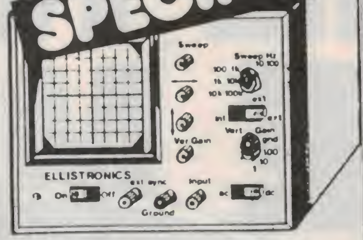
ELLISTRONICS • ELLISTRONICS • ELLISTRONICS

289 LATROBE ST., MELBOURNE 3000
PHONE (03) 602 3282 - 602 3836 TELEX AA 37758 LSTRON

EXTRA SPECIAL

HOBBY CRO!

SPECIFICATIONS
Weight: About 3.8kg
Size: 202mm(w) × 160mm(h) × 306mm(d)
Usable Bandwidth: D.C. to 6.5 MHz plus.
Vertical deflection sensitivity: 10mV per division
Horizontal deflection sensitivity: 500mV per division
Time base sweep frequency: 10Hz to 100kHz in 4 ranges
Synchronisation: internal and external.



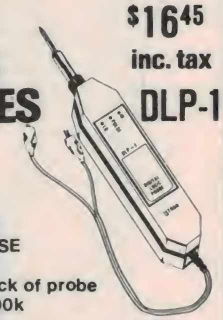
$155 EXEMPT
+$182.12 INC TAX
$6.00 Freight

ALL PRICES PLUS TAX IF APPLICABLE

Sales Tax Code:
A: 30%
B: 17½%

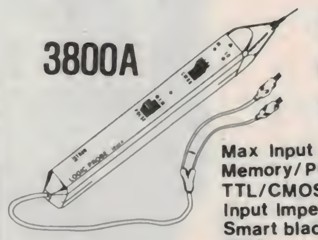
2 NEW LOGIC PROBES

DLP-1 $14.00 / $16.45 inc. tax



Max Input 1.5MHz
Strong Aluminium case
LEDs: HI - LOW - PULSE
80cm leads
KEY to LEDs on back of probe
Input Impedance 300k

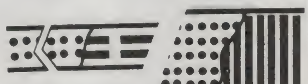
3800A $22.00 / $25.85 inc. tax



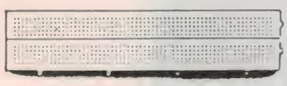
Max Input 10MHz
Memory/Pulse Sw.
TTL/CMOS Sw.
Input Impedance 300k
Smart black plastic case
53cm leads

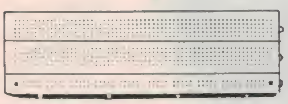
NEW! BREAD BOARDS

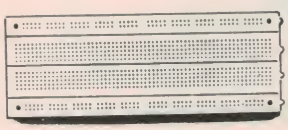
Now DIRECTLY imported at ½ cost of other breadboards!

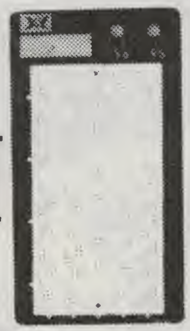

"Cut-away" view


WB-DN 100 Holes **$1.98** **$2.32** INC. TAX

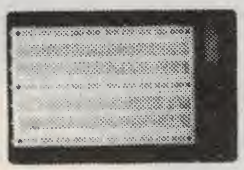

WB-TN 640 Holes **$7.57** **$8.89** INC. TAX

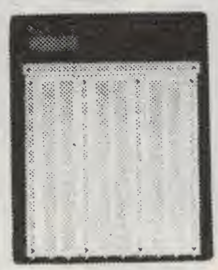

WB-2N 100 + 640 Holes **$9.65** **$11.33** INC. TAX

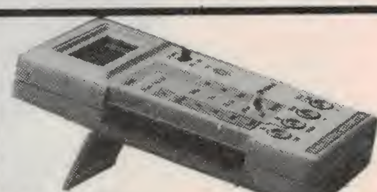

WB-2N 200 + 640 Holes **$11.21** **$13.17** INC. TAX


WB-4N-3 100 + 1280 Holes **$19.59** **$23.01** INC. TAX


WB-4N 400 + 1280 Holes **$25.03** **$29.41** INC. TAX


WB-4N-1 300 + 1280 Holes **$23.50** **$27.61** INC. TAX


WB-6N 500 + 1920 Holes **$35.58** **$41.80** INC. TAX



NOW IN STOCK —
LUTRON DIGITAL LCD MULTIMETER
3½ Digit, 5" Display, 10 meg input, Transistor HFE Tester up to 10 amp. DC current. 1% accuracy.
$62 plus 17½% Tax if applicable.

	1-24	25-99	100 plus
2708	4.50	3.55	3.25 B
2716 5V	4.75	3.95	3.50 B
2732 5V	8.50	7.95	7.50 B
2114 300NS	1.95	1.75	1.50 B
4116 200NS	1.95	1.80	1.50 B
4116 250NS	1.35	1.28	1.20 B
8264 64 x 1K RAM	45.00	P.O.A.	P.O.A.
8414 x 4 CMOS RAM	5.20	P.O.A.	P.O.A.
Z80CPU 2 MEG	10.76	7.16	6.73 B
Z80ACPU 4 MEG	13.50	9.59	9.01 B
Z80 P10	6.95	5.17	4.86 B
Z80A P10	9.18	6.64	6.24 B
Z80 CTC	6.95	5.19	4.88 B
Z80A CTC	8.48	6.09	5.73 B

	1-24	25-99	100 plus
BC547-8-9	.11	.09	.07 B
BC557-8-9	.11	.09	.07 B
RED LEGS 5mm	.12	.09	.07B
IN 4002	.05	.04	.035 B
IN 4004	.07	.05	.04 B
IN 4007	.12	.09	07 B
2N 3055	.65	.55	.49 B

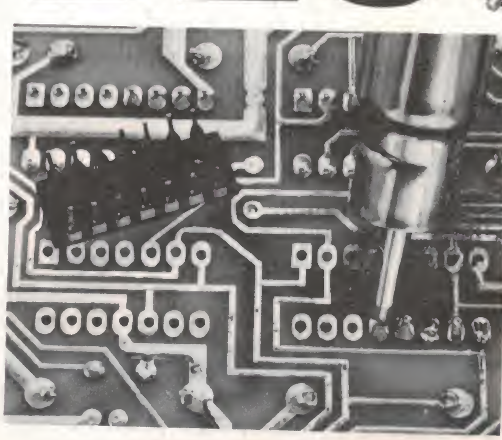
PACK & POST UP TO $25 = $2
PACK & POST UP TO $50 = $3
PACK & POST UP TO $100 = $5

ALL COMPONENTS ARE PRIME SPEC AND ARE FULLY COVERED BY MANUFACTURERS' GUARANTEE.

ELLISTRONICS • ELLISTRONICS • ELLISTRONICS • ELLISTRONICS • ELLISTRONICS

THE NEW PACE MICRO

DESOLDERER



Repair PCB's Anywhere!

Finally there's a power desoldering and soldering system that's so portable, you can use it anywhere. Depot. Service centre. Mobile van. On site. Anywhere! Yet it will even outperform most bench top systems in key areas:

- One-minute warm-up • Precise tip temperature control
- Spike-free operation • Finger-activated vacuum
- Desoldering and soldering with one handpiece
- AC and 12VDC source operation
- Compact and lightweight

Call or write today for FREE brochure:

COLTRONICS TRADING COMPANY
8 Gipps Road, Greystanes, 2145
Telephone: SYDNEY (02) 636 7211
NZ WAIKANAI 6739

PACE®
Micro Portable
Systems for PCB Repair Anywhere™

Lab Notes

A look at the versatile 4046B

The 4046B CMOS chip is probably one of the most versatile and least-used of all the ICs in the CMOS range. The device glories in (or suffers from) the descriptive title of 'micropower phase-locked loop' and there is a widespread misconception amongst many electronics amateurs and professionals that the device can only be used in PLL-type applications. In fact nothing could be further from the truth.

Ray Marston

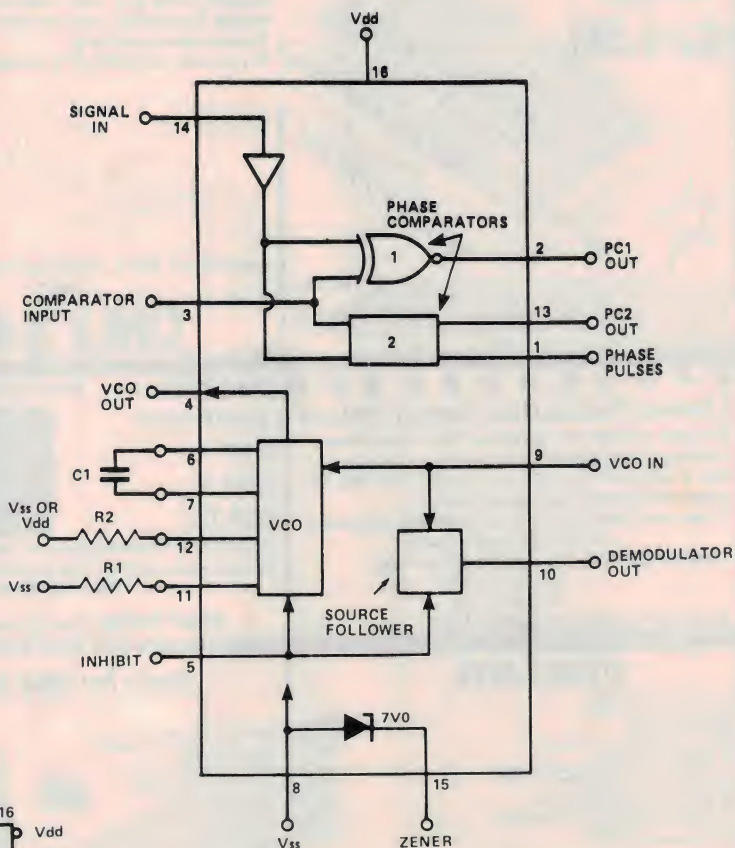
THE 4046B CONTAINS a pair of phase-comparators, a zener diode and one VCO or voltage-controlled oscillator. All of these sections are independently accessible via the IC pin-outs. The VCO section of the device is probably the most versatile and cost-effective voltage-controlled oscillator on the market. It produces a well-shaped symmetrical square wave output, has a top-end frequency limit in excess of 1 MHz, can be voltage-scanned through a 1 000 000:1 range (1 Hz to 1 MHz) when used with a single timing resistor or through any range from 1:1 to infinity (0 Hz to 1 MHz) when used with a pair of timing resistors.

If that were not enough, the voltage-controlled oscillator can also be independently gated on and off via an INHIBIT terminal, can be operated from any supply in the range 3-18 V and can, when used in conjunction with one of the 4046B's phase comparators, produce a two-phase output. The linearity of the VCO is typically a healthy 1% or so.

4046B VCO circuits

Figure 1 shows the internal block diagram and the pinouts of the 4046B phase-locked loop IC. The device contains two types of phase comparator, a VCO and a zener diode. In practical PLL applications, the VCO and one or other of the comparators are interconnected to form a 'loop', which causes the VCO to lock to the mean frequency of an input signal connected to pin 14.

For our present purposes the most important element of the IC is the VCO, ▶



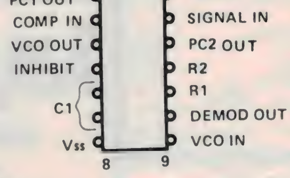
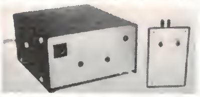


Figure 1. **Internal block diagram and pin-out of the CD4046B micropower phase-locked loop CMOS IC.**

MORE QUALITY KITS AT A LOW PRICE = JAYCAR!

INFRA RED REMOTE CONTROL BARGAIN

Refer "Electronics Australia" May 1981
We've slashed the cost of this great COMPLETE as specified kit. We need the cash so you get a bargain!



WERE $65 for complete kit
NOVEMBER ONLY $50!!!

SAVE $15

SOUND LEVEL METER

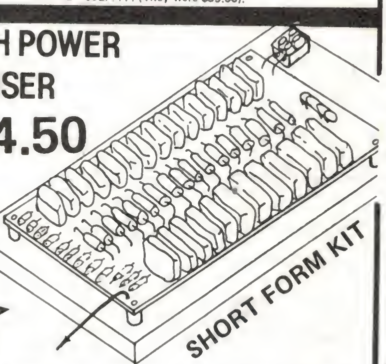
ONLY $32

SAVE $7.50

(Ref: EA May 1981)
A must for audio or enviroment · conscious people. This unit has specifications which are only matched by meters costing up to hundreds of dollars more!!!
GREAT VALUE AT ONLY $32. . . . . (They were $39.50).

HIGH POWER IONISER

$24.50



SHORT FORM KIT

The Jaycar ionizer runs directly from the 240V mains and is capable of producing a high intensity electric field. Output voltage of the unit is around 7.5KV.
This remarkably low cost ionizer has been produced for the enthusiast who wishes to experiment with the effects of ionized atmospheres. We must emphasise that whilst this ionizer can be made to produce small quantities of ozone it will not do so unless you specifically configure it to do this.

CMOS Specials Back!!

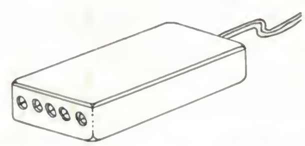
We have bought the entire stock of the mail order company 'Micronics' of Randwick NSW. They wanted to get out of the business so their loss is your gain!
Most of the CMOS below are the 'AE' type (NOT B but they are prime spec. brand new stock.

PART NO.	NORMALLY	THIS MONTH
4000AE	0.40	0.25
4002AE	0.48	0.25
4006AE	1.10	0.50
4012AE	0.35	0.20
4014AE	2.50	1.00
4018AE	1.50	0.50
4023AE	0.28	0.15
4026AE	2.20	1.00
4028AE	1.18	0.50
4029AE	1.25	0.55
4035AE	1.30	0.50
4047AE	1.20	0.50
4050AE	0.60	0.30
4051AE	0.95	0.40
4055AE	2.55	1.00

COMPLETE IONISER KIT

BY POPULAR DEMAND

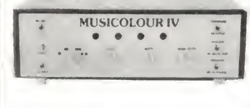
Based on the Jaycar High Power Ioniser short form kit (see left).
This unit has redesigned PCB, HIGH EFFICIENCY EMITTER HEAD that fits inside a high quality moulded ABS box with matching lid. The whole ioniser fits INSIDE the box with only a 2-core figure-8 mains flex protruding.
If you want a COMPLETE ioniser this is it!!



– WHY PAY WELL OVER $80 FOR AN INFERIOR UNIT?

ONLY $45

MUSICOLOR IV



ONLY $94.50

* * * * * * * * * *

(Ref: EA August 1981)
This is our third production run! Remember our kit uses the originally specified box (which means that the front panel fits!). Don't forget also that this is a chaser (4 channel) AS WELL AS a 4 channel Musicolor!!

Great lightbank to suit above unit ONLY $29.50 (Check last months ad for details).

ETI current trip car alarm

(Ref: ETI July 1981)
A great kit that is easy to install and has inbuilt false-trigger preventative mechanism. This kit has been held up due to non-availability of the LM394 I.C. This device is now becoming available.
Kit in Diecast box (complete).

ONLY $24.50

Light up your life

We know that it's crazy but we're doing it anyway. For the month of November ONLY we have gone crazy with panel lamps. If you buy ANY Jaycar panel lamp that uses an incandescent (i.e. Lilliput or MES) bulb we will give you

50% OFF!!

And that's 50% off the best price anyway!!!

We have about the biggest range of panel lamp bezels in Australia. So call in!!

$7.50 ME–533 MULTIMETER CURRENT SHUNT

Hand made. Plug into your meter.
Measures up to 20 AMPS with direct meter readout.
VERY ACCURATE
See our other ads for this great DMM - $49.95

* * * * * * * * * * * *

Useless Pushbutton Switch Sellout

We have zillions of innocuous little pushbutton switches. They can be used for many purposes (i.e. like a bell-push etc) but are basically too large for electronic games or computer projects.
If you can figure out a use for them you will save a FORTUNE in November
They are normally $1 but November only
15c each! 1-off
10c each! 10+
(Ask us for a higher quantity price!!)

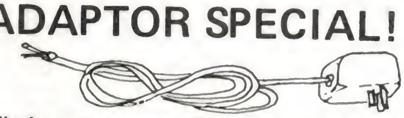
PHOTON TORPEDO KIT ONLY $24.50

Ref: EA Sep. 1981

Complete kit including special panel with deep Space Background and Star-Trek Warship!!
ONLY $24.50!!!

STOP PRESS: EA CDI ref: May '75
Normally $35 NOW $25 SAVE $10

FERGUSON PLUG ADAPTOR SPECIAL!



Fully Australian approved Plug Pack type PPA 1024.
Can supply 30V r.m.s. AC @ 250mA!!
We still have a few left despite massive sales when they were on special in September. These units normally sell for $8.50 – be quick to get one before they are out of stock!
SORRY – due to weight, personal shoppers only or $2.00 post and packing.

ONLY $3.00!! SAVE OVER 60%

We now stock ELLISTRONICS plug-in Experimenter Boards!

OTHER KITS

ETI (In no particular order!)	
446 Audio limiter (short from)	$9.00
480/50 watt Module	$23.00
480/100 watt Module	$27.00
480 2 Input preamp/mixer (short form)	$30.00
466 300 watt amp module	$70.00
477 100 watt MOSFET module (inc. bracket)	$59.00
473 Moving Coil preamp absolutely complete	$74.50
735 UHF convertor complete	$32.50
458 Peak level meters NOT $37.50 BUT	$29.50
480/100 complete slave P.A. inc. P/S and box	$130.00
581 +/-15V Power Supply	$15.50
445 General purpose preamp	$7.99
JAYCAR'S OWN KITS	
88 note (7¼ octave) electric piano kit	$589.00
4–voice polyphonic string synthesiser	$445.00
3002-SP Speaker protector 2 channel	$15.50
3002-PM Power meter (LED) 2 channel	$15.50
ELECTRONICS AUSTRALIA KIT	
Fuzz box complete EA Feb (See above for other EA kits).	$19.50
ETI729 UHF Masthead Amp	$35.00
EA 'Le Gong'	$14.95
EA 'P.C. Birdies'	$14.95

parts for new kits

(Once again in no particular order)	
ETI (ALL pcb's are fibreglass)	
330 Car alarm PCB	$2.50
729 UHF masthead amp PCB	$2.50
735 UHF convertor PCB set	$2.50
458 Peak reading meters PCB	$3.55
446 Audio limiter PCB	$3.50
5000 Preamp metalwork set	$99.00
478mc Moving Coil cartridge PCB	$3.50
478mm Moving Magnet cartridge PCB	$3.50
5000 Power amp heatsink front panel	$49.50
5000 Power amp complete metalwork	$99.00
EA.	
75CD-7 Cap Discharge Ignition PCB	$2.50
81GA-3 Graphic analyser PCB	$9.50
81CC-5 'PC Birdies' PCB	$2.50
81AO-6 Audio oscillator PCB	$3.70
81SP-5 Sound pressure meter PCB	$3.00
81RC4A / 81RC4B 2 channel IR control / 81RC4C	$1.50 each

P.S. We have lots of 'vintage' ETI PCB's. See our 'Specials' ad last month or call in!

POST AND PACKING: $5–$9.99 ($1.00): $10 – $24.99 ($2.00): $25 – $49.99 ($3.00): $50 – $99.99 ($4.00) $100 up $5.50

Jaycar

NOTE! NEW SHOP HOURS
Mon - Sat 9am – 5.30pm
Sun - 10am – 2pm
Open Thursday night until 8pm.

380 Sussex St Sydney 2000
Ph. 2646688 Telex 72293
Mail Orders To: Box K-39 Haymarket 2000

Lab Notes

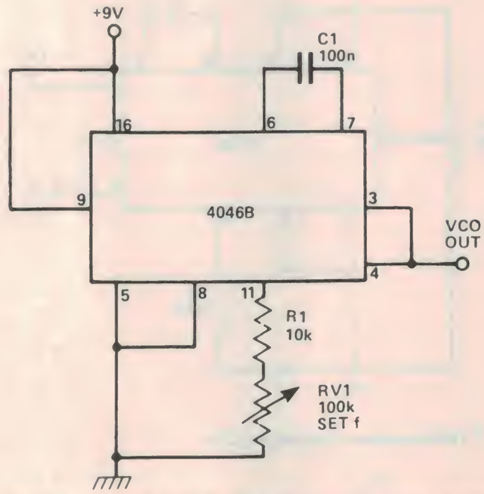


Figure 2. **Simple variable-frequency (200 Hz to 2 kHz) square wave generator.**

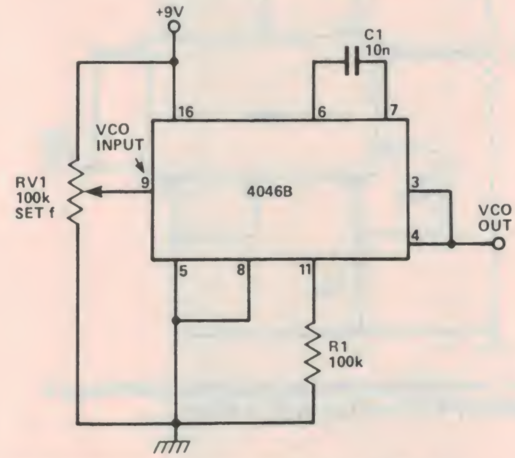


Figure 3. **Wide range VCO with frequency variable from near zero to 1.4 kHz via the pin 9 voltage.**

or voltage-controlled oscillator. The operating frequency of the oscillator is governed by the value of a capacitor connected between pins 6 and 7 (minimum value 50 pF), by the value of a resistor wired between pin 11 and ground (minimum value 10k) and by the voltage applied to VCO-input pin 9 (any value up to the supply voltage in use).

Figure 2 shows the simplest possible way of using the VCO section. Here, the pin 9 'voltage control' input is tied permanently high and the circuit acts as a basic square wave oscillator, with its frequency variable over a 10:1 range by RV1. Note at this point that the VCO output (pin 4) is tied directly to the pin 3 phase comparator input. If pin 3 is allowed to float, the comparators tend to self-oscillate at about 20 MHz and superimpose an HF signal on the top part of the VCO output waveform.

Ranging far and wide

Figure 3 shows how to connect the 4046B as a wide-range VCO. Here, R1-C1 determine the top (maximum) frequency that can be obtained and RV1 controls the actual frequency via the pin 9 voltage. The frequency falls to near zero (a few cycles per minute) with pin 9 at 0 V. The effective control range of pin 9 varies from roughly 1 V below the supply value to 1 V above zero, i.e: RV1 has a 'dead' control area of several hundred millivolts at either end of its range.

Figure 4 shows how these 'dead' areas can be eliminated by wiring a silicon diode in series with each end of RV1. The circuit also shows how the minimum operating frequency can be reduced to absolute zero by wiring a high value resistor (R2) between pins 12 and 16. Note here that, when the frequency is reduced to zero, the VCO output randomly settles in either the logic 0 or logic 1 state.

Figure 5 shows how the pin 12 resistor can alternatively be used to determine the minimum operating frequency of a restricted-range VCO. Here, f_{min} is determined by R2-C1 and f_{max} is determined by C1 and the parallel resistance of R1-R2.

Figure 6 shows an alternative version of the restricted-range VCO, in which f_{max} is controlled by R1-C1 and f_{min} is determined by C1 and the series com- ▶

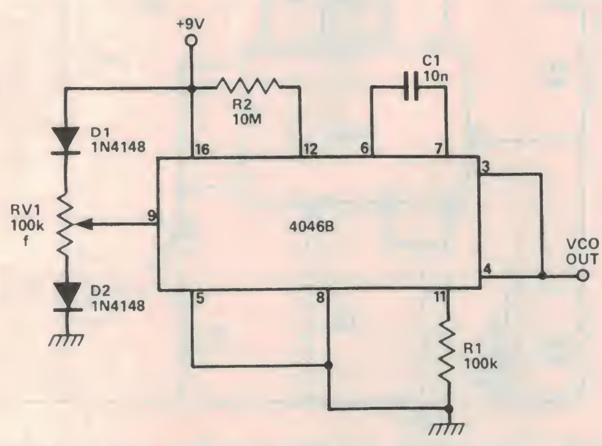


Figure 4. **Wide range VCO with frequency variable down to absolute zero.**

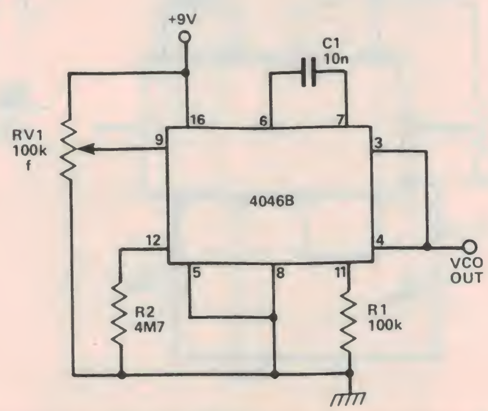


Figure 5. **Restricted range VCO with frequency variable from 60 Hz to 1.4 kHz by RV1. R2 acts as an offset resistor.**

Lab Notes

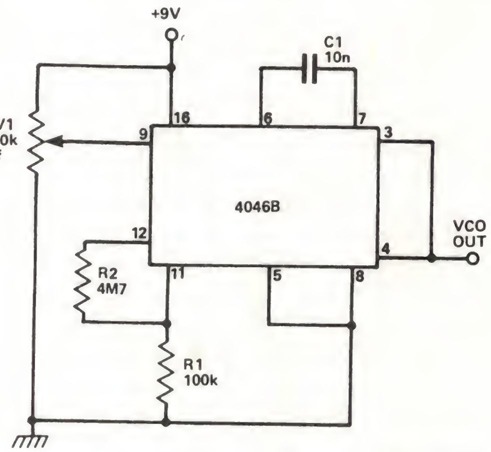


Figure 6. **An alternative restricted range VCO, in which f_{max} is controlled by R1-C1 and f_{min} by (R1 + R2)-C1.**

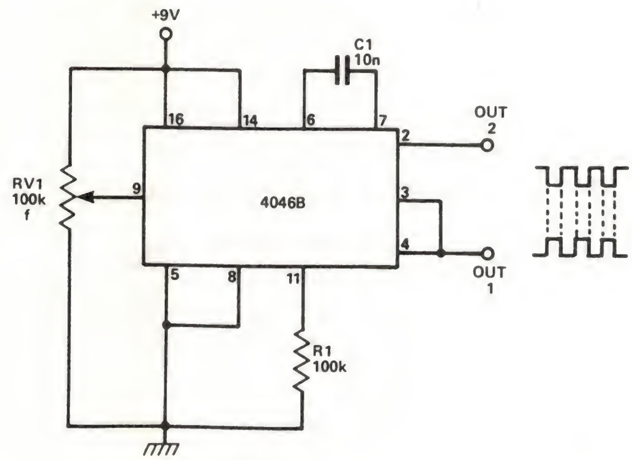


Figure 7. **A two-phase wide-range VCO.**

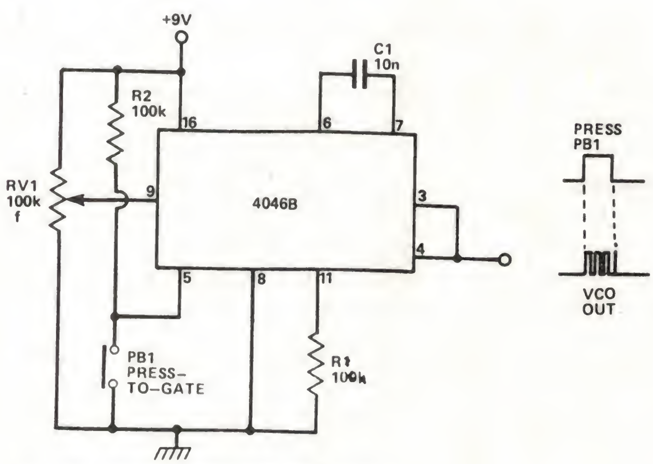


Figure 8. **A manually gated wide-range VCO.**

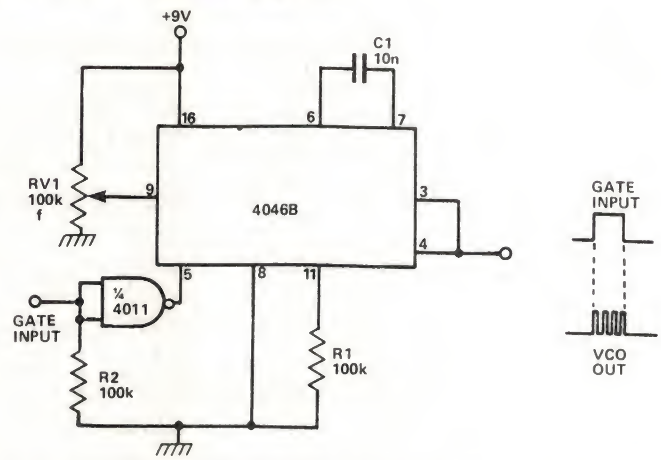


Figure 9. **An electronically gated wide-range VCO, using an external gate inverter.**

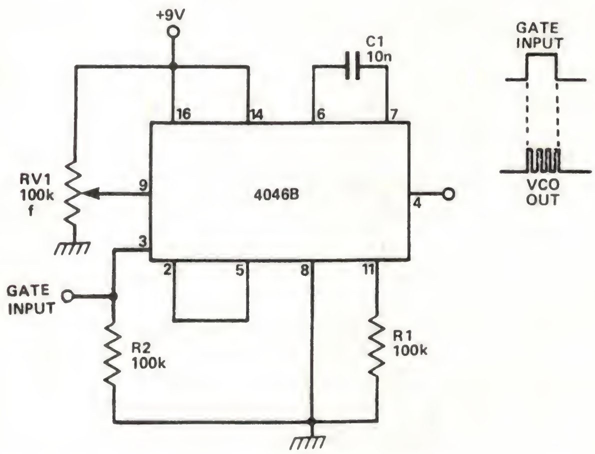


Figure 10. **An electronically gated wide-range VCO using the internal EX-OR phase detector for gate inversion.**

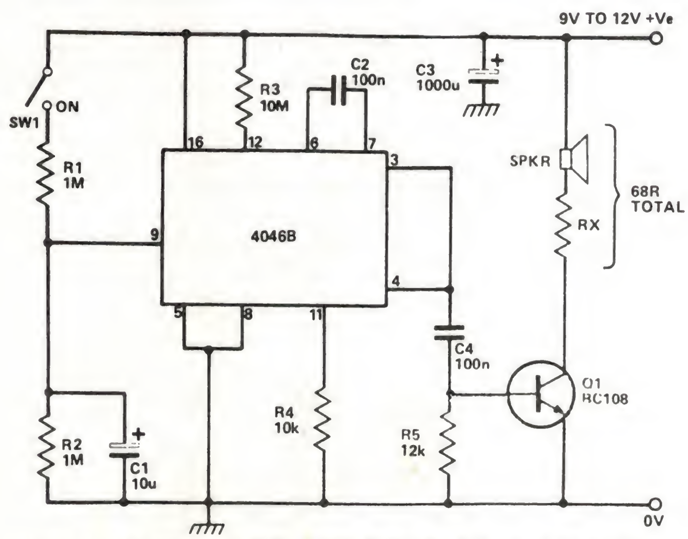


Figure 11. **An electronic siren giving slow rise and fall of its operating frequency.**

bination of R1 and R2. Note that, by suitable choice of the R1 and R2 values, the restricted-range VCO can be made to span any range from 1:1 to near infinity.

Square pair

The VCO can be made to generate a pair of anti-phase square wave outputs by connecting its output to the phase-comparator input, taking the signal input (pin 14) high and taking the anti-phase output from pin 2. Figure 7 shows the connections. Note that this circuit makes use of the IC's built-in EX-OR gate (phase comparator 1).

The VCO section of the 4046B can be disabled by taking pin 5 of the package high (to logic level 1). This feature enables the VCO to be gated on and off by external signals. Figure 8 shows how the VCO can be manually gated via a pushbutton connected directly to pin 5, while Figure 9 shows how the circuit can be gated electronically by an external gate inverter. Alternatively, if the two-phase output facility is not required, the internal EX-OR phase detector can be used to provide gate inversion, as shown in Figure 10. Note in this latter case that pin 4 is not connected to pin 3.

Sirens and sound effects

Figures 11 to 14 show some practical siren and sound effects generator VCO circuits. Figure 11 is a conventional siren circuit. When SW1 is closed, C1 charges exponentially via R1 and the VCO frequency rises slowly from zero to a maximum value. When SW1 is opened, C1 discharges via R2 and the operating frequency slowly decays to zero. The VCO output is ac-coupled to the speaker via C4 and Q1.

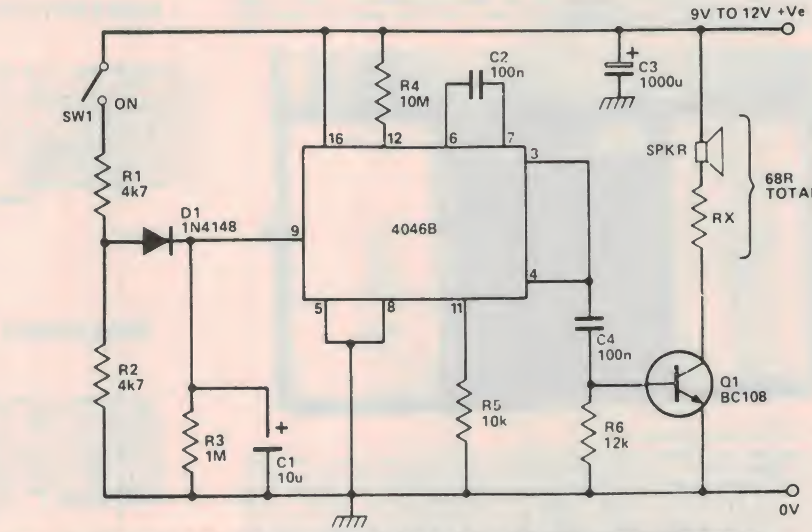


Figure 12. **This quick-start siren gives a rapid rise and slow fall of its operating frequency.**

The Figure 12 quick-start siren is similar to the above, except that C1 charges rapidly to half supply volts via R1, R2 and D1 when SW1 is closed and discharges slowly via R3 when SW1 is opened.

The Figure 13 circuit produces a 'phaser' sound when PB1 is closed. The 4011 astable is gated by PB1 and produces a chain of 4 ms pulses at intervals of 70 ms. Each pulse rapidly charges C2 via R3 and D2, to produce a high tone that then decays rapidly as C2 discharges via R5, only to be repeated again on the arrival of the next pulse.

The Figure 14 circuit generates either a pulsed tone or a warble tone signal (depending on the setting of SW1) when PB1 is closed. PB1 is used both to enable pin 5 of the 4046B and to gate on the 4001 astable, which then applies a rectangular (alternatively fully high and fully low) waveform to pin 9. In the pulsed mode the VCO generates zero frequency when pin 9 is low. In the warble mode it generates a tone that is 20% down on the high tone when pin 9 is low.

Miscellaneous VCO circuits

Figures 15 to 17 show a miscellany of 4046B VCO circuits. The Figure 15 circuit is that of an FSK generator which produces a 2.4 kHz tone when a logic 1 signal is applied to pin 9 and a 1.2 kHz tone when a logic 0 signal is ▶

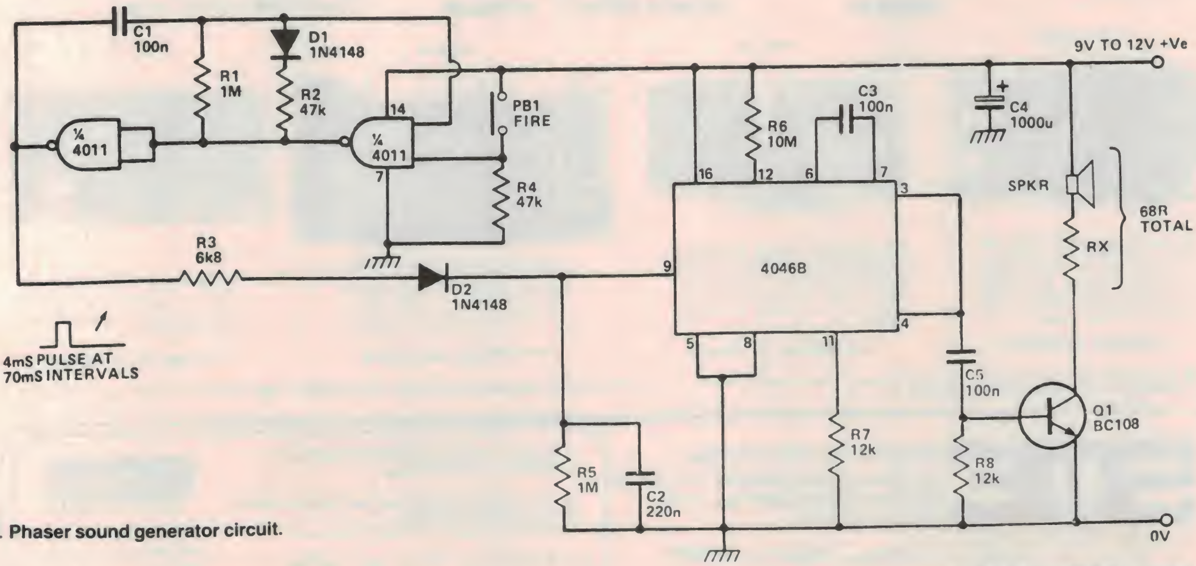


Figure 13. **Phaser sound generator circuit.**

S100-Z80 MICROCOMPUTERS

PMS100

Introducing the PMS100 by SME Systems, an all new package microcomputer based on a Z80 CPU. This system will suit all users ranging from computer technicians, programmers and small to medium company accounting requirements.

Technical specifications are as follows:

4 Mhz Z80 CPU, 64K Dynamic memory with bank select to allow up to 8 pages of 64K each, and up to 256K of RAM on a single board, RS232 serial port and 8 bit parallel ports. Up to 16K EPROM which can be switched out after power up to allow a full 64K of user RAM per bank. Dual QUME 8" d/sided drives running at single or double density. Density selection is automatically chosen by the use of double or single density formatted disks. External Mini drives can also be interfaced to the controller. The DOS supplied is compatible with standard CP/M and CDOS to allow a wide selection of software to be used, such as MBASIC, CBASIC, COBOL, ALGOL, PASCAL, FORTRAN, ASSEMBLY LANGUAGE, WORD PROCESSING, MULTI-USER, MULTITASKING, AND ACCOUNTING PACKAGES. All of which can be supplied from SME Systems.

The PMS100 is AUSTRALIAN designed and built and can be supplied as a basic system or as a complete turnkey system including terminal, printer and software.

DATASOUTH DS180

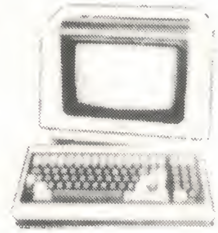
The Datasouth Printer is a 180 cps dot matrix printer with a long list of features:— bi-directional/logic seeking, 1000 character buffer, 9 x 7 dot matrix, expanded characters, 1 to 6 paper copies, 96 ASCII char. set, 132 column print width, tractor feed (adjustable), top of form, 6/8 LPI, parallel & serial interface, perforations skip-over, self test, floor mount stand & paper holder.

$2995.00

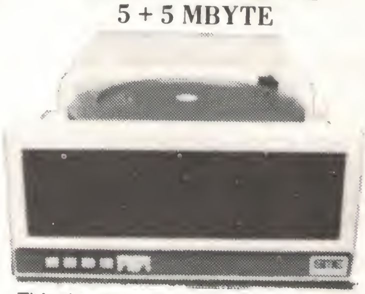
TELEVIDEO TVI-950

The Televideo TVI 950 terminal is a smart 80 x 25 display with detached keyboard and a host of features:— advanced editing with wraparound, smooth scrolling, 15 baud rates, printer port (RS232), protected fields, underlining, split screen, programmable function keys, 15 special graphic characters, non-glare & tiltable screen.

$1595.00



CARTRIDGE DRIVE 5 + 5 MBYTE



This is the way to bring mainframe storage to the micro's. It allows hard disk advantages with built in back up. We have software & hardware to interface to S100, Apple & Tandy systems. Easy to install & operate, removable media, built in 512 byte buffer, high speed LSI controller, can daisy chain up to 4 drives.

$6250.00

DUAL 8" DRIVE

A new product from SME is a dual drive package available in a bench mount or rack mount style. It uses dual 8" double sided, double density compatible drives, in a low profile cabinet. Built in power supply, line filter & cooling fan. Drive interface is via a 50 way centronic type connector. This unit is supplied assembled & tested.

RACK MOUNT $1800.00
BENCH MOUNT $1750.00

S100 CARD CARE

R/M KIT $325.00
R/M A&T $425.00
B/M KIT $365.00
B/M A&T $465.00

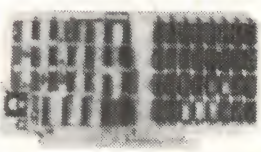
Available in rack mount or bench mount. Built in power supply 8v @ 15 amps + & — 16v @ 2 amps, key switch, reset switch, fan cooled power supply, 11 slot mother board, supplied with 5—S100 edge connectors, all power supply rails are fuse protected. Also available in 6800 format.

SBC-400

Z80 single board computer, 4MHz, 16K EPROM, 1K RAM, 16K EPROM, 1 serial port, 1 input & 1 output parallel port, power on jump, 2K monitor 2716,4 channel counter/timer, software controlled baud rate generator, modem look alike, vectored interrupt.

KIT $395.00 A&T $465.00

DRC-II



Bank select, 200 nS chips standard up to 4MHz speed, will accept 64K rams to give 256K per board, switch selectable boundaries, invisible refresh, phantom output disable, standard S100 plated thru holes, solder resist, components overlay.

KIT $650.00 A&T $750.00

FDC-II

Operates with single & double den. single & double sided drives & 8' or 5' drives in any combination of 4 drives simultaneously, phase lock loop data recovery, with SDOS operating system you can run all CP/M and CDOS programmes

KIT $395.00 A&T $465.00

SPC-29

Dual serial ports with RS232 & TTV outputs, nine programmable parallel ports, wire wrap cross link area for parallel I/O, switch selected, plated thru holes, solder resist

KIT $205.00 A&T $245.00

2708 Eprom card K $85, A&T $98; Extender card K $35, A&T $48; Extender/Terminator K $85, A&T $105; Wire wrap card $38.50; FDC—I Disk controller K $295, A&T $345; Eprom programmer K $255 A&T $295; 8024 M. M. Video card K $315 A&T $385.

SME SYSTEMS

Melbourne: Ph (03) 874 3666.
22 Queens Street, Mitcham, Vic. 3132.
PO Box 19 Doncaster East, 3109.
Telex: AA37213.
DEALER: Adelaide — 267 5277

Send 66c in stamps for COMPUTER PRINTOUT CATALOGUE for more details

ALL PRODUCTS AUSTRALIAN MADE AND EX STOCK (ALMOST)
DEALER ENQUIRIES WELCOME
Prices and specs subject to change without notice

All prices tax free, for retail prices add 17½ per cent.

bankcard
welcome here

Give name, number, expiry date and signature for mail order sales.

Lab Notes

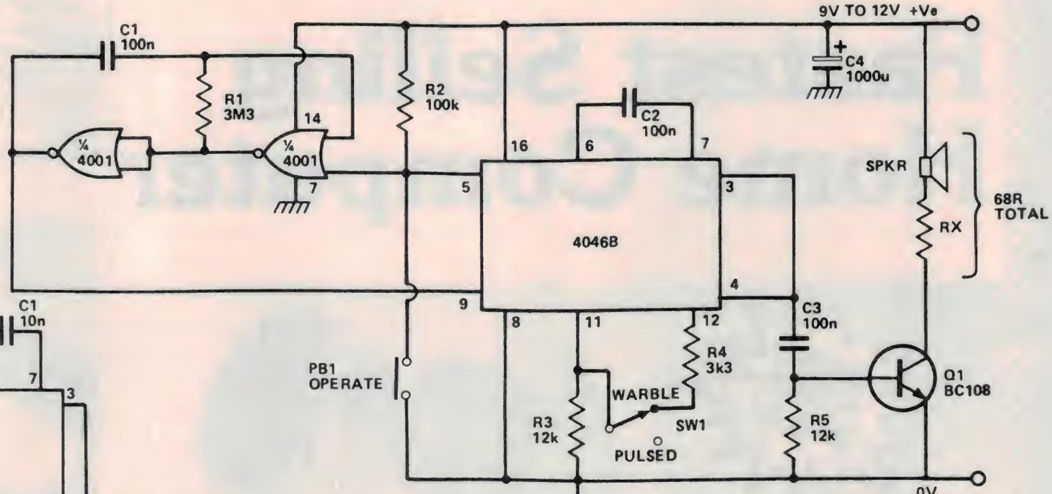


Figure 14. **Combined pulsed tone/warble tone alarm generator. The high tone is determined by R3, the low tone by (R3+R4).**

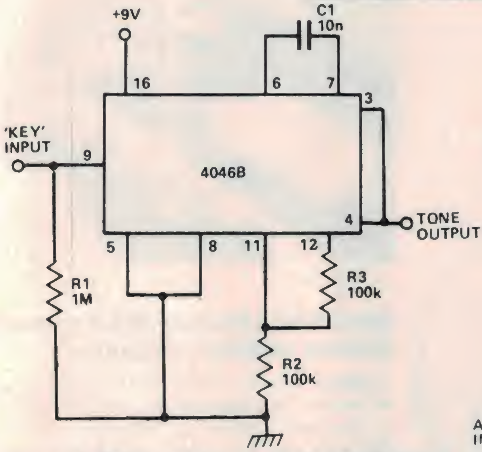


Figure 15. **FSK generator — logic 0=1.2 kHz, logic 1=2.4 kHz.**

applied. The high tone is controlled by R2 and the low tone by R2 and R3.

Figure 16 is a 220 kHz FM generator. The internal zener of the 4046B (pin 15) is used to provide a stable 7 V supply to the x20 3140 inverting amplifier, which is quiescently biased at 3.5 V by the R2-R3 potential divider. The pin 9 VCO signal is thus a mean 3.5 V potential amplitude modulated by an amplified version of the AF input signal, which thus frequency-modulates the output of the VCO.

Running down

The Figure 17 circuit is that of a run-down clock generator of the type used in dice and roulette games. When PB1 is pressed, C1 charges to a high voltage via D2. Simultaneously, Q1 is biased on via D3-D4 and effectively connects R6 between pin 11 and ground. Under this condition, the VCO operates a high frequency (tens of kHz) and effectively generates a random number of clock pulses. When PB is released, Q1 turns off and the VCO timing is governed by R8. Simultaneously, C1 rapidly discharges to half supply volts via R1-R2-D1, so the VCO operates at only 100 Hz or so. C1 then slowly discharges via R3 and the VCO frequency slowly decays to zero over a period of about 15 seconds. ●

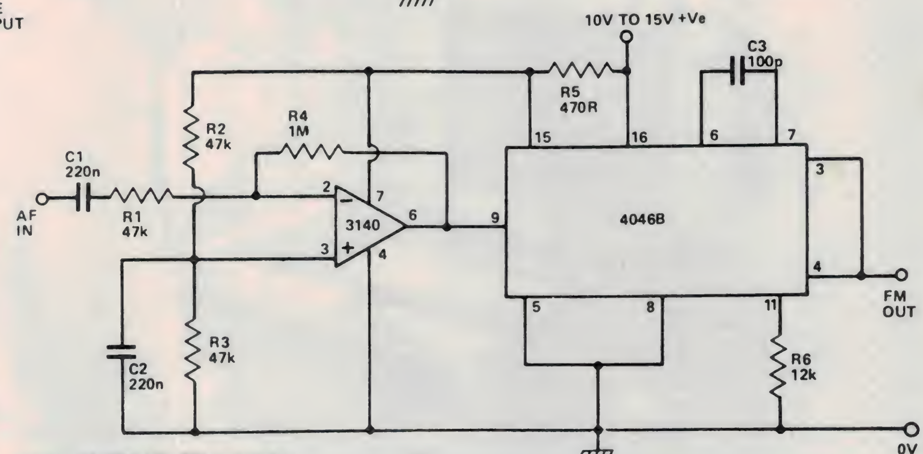


Figure 16. **220 kHz FM generator.**

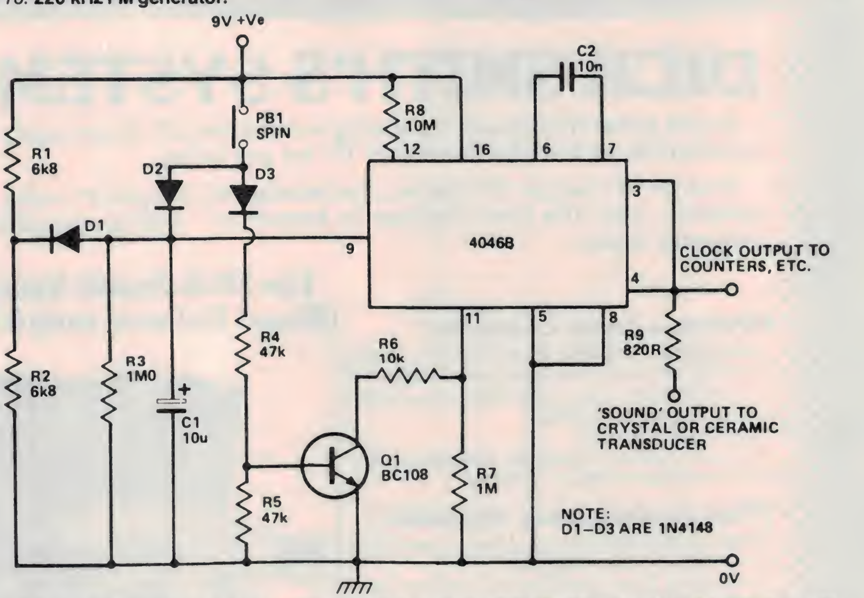


Figure 17. **Run-down clock/sound generator for use in dice/roulette games. The circuit is suitable for use with edge-sensitive clock circuits only. The output can be used to directly clock most types of counter and can be fed, via R9, to crystal or ceramic transducers to directly produce 'run down' sounds. When the run-down is complete this circuit may settle in either logic 0 or 1, so it cannot safely be used to clock level-sensitive circuitry.**

Australia's Fastest Selling Home Computer

DICK SMITH'S SYSTEM 80

In just a few short years, operating a computer will be as much a part of everday life as the calculator and TV set are today.

And it's the people that have a knowledge of computers today that will certainly have the best chances in tomorrow's highly competitive and technical world.

What is a home computer?

The ultimate multiple TV game. An untiring tutor who will teach you almost anything and at your own speed. A way of familiarising yourself with computer technology.

How does it do this?

With the help of computer programs available on common audio cassettes.

What programs are available?

Virtually an infinite range: from us, and from thousands of other suppliers.

Everything from teaching the kids to read properly, teaching yourself to type . . . right through to programs which will help you run your business and even do your income tax calculations for you!

And, as we said before, once you understand your computer, you'll be able to write your own programs to do just what YOU want to do!

The Dick Smith System 80. Great Value at only $750.00

This is just a sample of the wide range of software available for use on your System 80.

Are they difficult to use?

Lets answer that question by asking you a question: Do you use a cassette recorder in your home?

The Dick Smith System 80 home computer is just as easy to use. You turn the computer on (just like turning on the cassette), pop in the program cassette, press the 'play' button (just like on your hi-fi cassette) and you're ready to go computing. You tell the program to run by typing the letters 'RUN' and you're away! The program itself generally tells you what to do next.

It couldn't be easier!

Why is the System 80 Australia's fastest selling computer?

Simply because it offers, by far, the best value for money for a practical computer system.

A 'practical system' quite simply means one that **you** can use (and that includes program availability).

There are cheaper computers, no-one is disputing that. But you need to be a boffin to work some of them out. Others have little or no programs available.

Yes, there are a lot of computers to choose from at the moment. Just like the early days of colour TV. Where have they all gone now?

Some computers are being offered as various bits and pieces. This is quite okay: as long as you understand what you are buying! The System 80 computer, as it comes to you, is a fully operational computer. You don't need to buy another thing to make it work: plug it in to a TV set and a power point – and it works.

Many other computers are little more than fancy plastic boxes: until you start buying the 'add-ons' to make them work, they're not much use to you.

Beware of seemingly attractive 'computer only' prices. Make sure you take into account the 'add-ons'!

And it's over $500 cheaper than the Tandy TRS-80!

If you buy the Dick Smith System 80, you'll save over $500 on the current Tandy computer.

The closest equivalent current model Tandy Computer is the TRS-80 model III, with 16K of memory, monitor, but no cassette recorder. Add a cassette recorder and the system sells for over $1450. We do not compare the System 80 against the TRS-80 model I as it has been discontinued in the USA, the country of manufacture and no longer sold here.

The Dick Smith System 80 is supplied with 16K memory and built-in cassette recorder. It doesn't need a separate monitor, as it will plug in to any TV set. If you do add a separate monitor, the price is only $899.

So you can save a bundle by buying the Dick Smith System 80 — and still have access to the huge range of software for the TRS-80!

A fundamental understanding of computer technology will secure their future in tomorrow's world.*

Want to know more?

We've prepared a detailed brochure showing you just what the Dick Smith System 80 Home Computer can do for you. All you have to do is ask for a copy.

Call in to your nearest Dick Smith store — have a chat with the helpful computer specialist in the store — or drop us a line and we'll gladly send you a copy free of charge.

Or even better . . .

Take advantage of our exclusive trial offer below. There's nothing better than 'hands on' experience! And you're under no obligation.

How will a home computer help my children?

From what we've said, you might imagine that a computer might make us lazy.

Far from it! Teachers report that students with access to computers at home are usually much more receptive to learning, and they learn faster. Consequently, they get better grades.

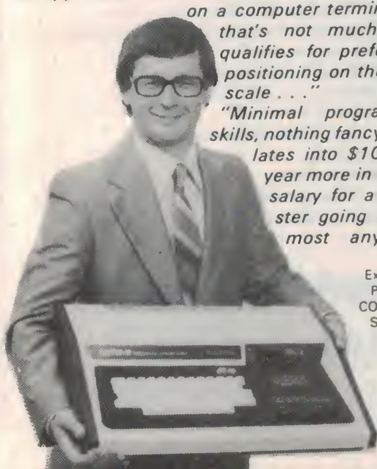
But a computer can do much more than this for your children. It can teach you to read better, understand English or Mathematics easier, learn spelling, even teach you to touch type or read music. And much, much more.

Very quickly, your children will learn how a computer works. What makes it go. You'll find that they're even writing their own programs after a few weeks. And the more they learn, the more they want to learn. Because they can see the results of their learning immediately, it's enjoyable, so they want to learn more and more!

*Read what a leading US magazine says:

"If a youngster graduates from school with no particular skills and applies for a job with Pacific (the local utility and telephone company) and if on the application he can claim 10 hours experience on a computer terminal and that's not much — it qualifies for preferential positioning on the hiring scale . . ."

"Minimal programming skills, nothing fancy, translates into $1000 per year more in starting salary for a youngster going into almost any job."



Extract from PERSONAL COMPUTING September, 1981

This is a list of private companies and Government departments who have chosen the System 80 computer above other brands.

Australia Post	RAAF Base Williamtown	Department of Health
Sydney University	Department of Navy	Macquarie University
Blue Metal Industries	Department of Home Affairs	Philips Consumer Products — Clayton
A.I.S. Port Kembla	Philips Comsumer Products	NSW Police Department
Lysaghts	University of Adelaide	

EXCLUSIVE 14 DAY TRIAL OFFER

If you've been thinking about a home computer for your family, but haven't quite been able to make up your mind, here's an offer you shouldn't miss out on, for your family's sake.

Buy a Dick Smith System 80 and use it in your own home for up to 14 days. If you're not completely happy, you may return it (as long as it is in original condition and packaging) for a full refund of the purchase price — no questions asked!

You can even charge it to your Bankcard if you wish: for extended credit should you require it.

With your System 80 computer, we'll send you a free pamphlet detailing the programs currently available from Dick Smith Electronics. And remember — there are literally thousands of other programs available that will run perfectly in your System 80 computer.

DICK SMITH Electronics

MAIL ORDER CENTRE: PO Box 321, North Ryde, 2113.
Phone: (02) 888 3200

Yes! I recognise the need for investing in the future. Please rush me a System 80 computer. (Cat. X-4005) I understand I can return it within 14 days for a full refund.
I include $760 ($750 plus $10 insured road freight anywhere in Australia)

Name ....

Address (not a PO Box!) ....

.... Postcode ....

Method of payment: Bankcard No. ....

☐ Cheque enclosed

☐ Postal Order enclosed Expiry Date ....

☐ Please charge to my Bankcard Signature ....

DSE/A061/LM

Here's a big winner for all you sports fans.

AMPOL Australian Sporting Records. **$24.95***

This 560 page hard cover book details all the records set by Australians in every sporting field. At home and overseas. It's the latest, updated edition. With all the facts, figures, names and places involved.

Plus new colour and black and white photographs capturing the action, the teams, the men & women setting records in all the traditional, unusual and contemporary sports.

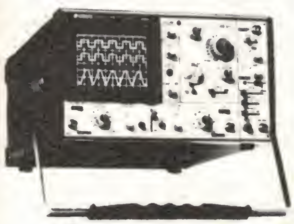
So if you're a sports fan, or you know one, Australian Sporting Records is a must. Make a gift of it to yourself, or someone else. You'll find it at newsagents, bookshops, department stores, or wherever books are sold.

Distributed by Gordon and Gotch Limited.
***Recommended retail price.**

BUD 0001

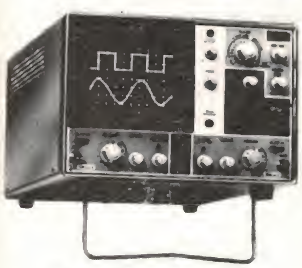
HITACHI OSCILLOSCOPES

2 YEAR WARRANTY



V550 50 MHz — $1995

Professional quality oscilloscope with many unique usable features: 50 MHz Dual Trace, Third Trace Trigger View, 1 mV/Div. Sensitivity, Delayed Sweep, X10 Sweep Magnification. Equivalent Oscilloscopes cost 100s of dollars more. Supplied under contract to the A.B.C.



V302 30 MHz — $949

Dual Trace 30 MHz 1 mV Sensitivity per division. Built in delay line plus many other features. Ideal for general purpose, transceiver and TV service, and digital use. The only 30 MHz 1 mV oscilloscope available for less than $1,000. In use by the CSIRO.

** New low price. **

V152 15 MHz — $570

Dual Trace 15 MHz, 1 mV Sensitivity, XY operation, TV sync separator circuit. Sweep times magnifier (10 times) Trace rotation Z Axio Input. Excellent value for money. Supplied to many Government Departments and National TV Service Companies.

Hitachi new generation oscilloscopes are unequalled for reliability, operating ease, technical features and value for money. You can confidently buy HITACHI Test Instruments for year after year of trouble-free use.

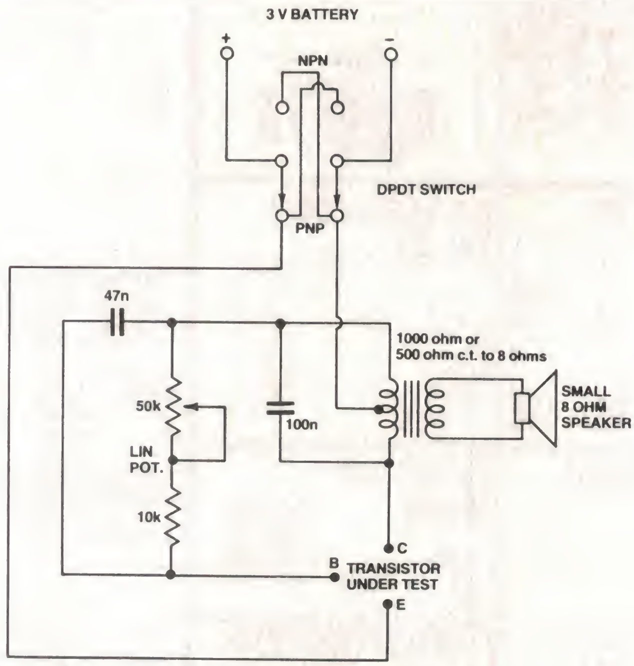
Prices + S/Tax 15%. Subject to change. FOT Sydney.

HITACHI AVAILABLE FROM:—
N.S.W. Radio Dispatch Service, David Reid Electronics, Standard Components, Emtronics. D.G.E. Systems Newcastle.
Vic. Ellistronics, G.B. Telespares, David Reid Electronics, ECQ Electronics, J. H. Magrath & Co. Pty. Ltd.
Qld. Audiotronics, ECQ Electronics, St. Lucia Electronics.
S.A. Bee Jay Electronics.
W.A. Reserve Electronics.
Tas. George Harvey Electric Launceston and Hobart

Standard Components Pty. Ltd. *"STOCKISTS IN ALL STATES"*
10 Hill St., Leichhardt N.S.W. 660-6066

Ideas for Experimenters

These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.



Quick transistor checker

This simple little circuit is quite effective for testing bipolar transistors, being a favourite of **Agostino Greco of Clayton in Victoria**, who has used it over the last few years.

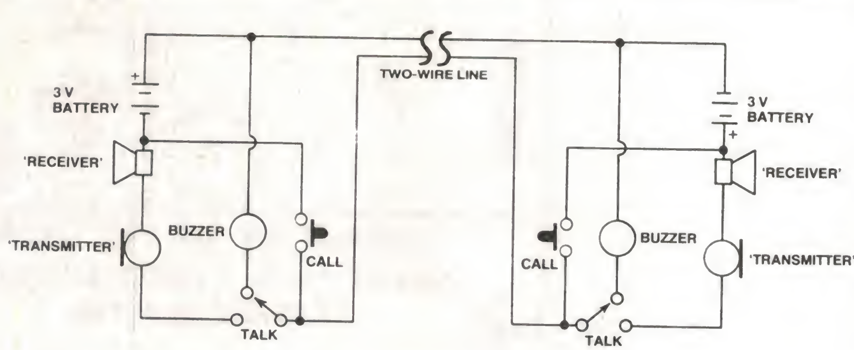
The circuit is a basic Hartley oscillator using a centre-tapped audio output transformer of the type commonly found in small transistor radios, driving a small 8 ohm speaker. The latter is a common item, stocked by many suppliers, or you can salvage one from a defunct transistor radio. You could salvage a suitable transformer from a defunct radio also, or you could obtain one of the models stocked by Tandy (catalogue No. 273-1380) or Dick Smith (catalogue No. M-0216).

A 50k potentiometer provides a means of varying the tone of the oscillator, from a low frequency at high values of resistance to higher frequencies at lower values of resistance. The series resistor is provided to limit the high frequency range, as otherwise the circuit may cut off, depending on the particular transistor being tested, and further to limit the maximum current drawn by the circuit to a value well under 50 mA at full setting of the potentiometer.

The two capacitors are in no way critical and serve to set the frequency of operation of the oscillator. They have been chosen to give a pleasing tone with a 50k potentiometer. Increasing the value of either capacitor will result in a decrease in the frequency of the oscillator.

In use, the transistor to be tested is connected to the circuit via crocodile clips. If there is no response from the circuit, then the polarity change switch should be toggled, and hopefully there will now be a tone output from the speaker. If there is no result with the switch in either position, then the device is faulty; alternatively it may be an FET, UJT or SCR, etc, type device, in which case this tester will be of no use.

Note that there will be no harm done to a transistor if it is initially connected up to the circuit with the polarity switch in the wrong position, as it will be reverse biased and hence will draw only small leakage currents.



The simplest intercom

This is just about the simplest intercom one could devise, according to **David Timmins of Pullenvale in Queensland**. Its big advantage is that only a two-wire line is required.

The 'receiver' and 'transmitter' may be salvaged from 'surplus' telephone handsets. The transmitter unit is a carbon microphone and the receiver unit is a rocking armature earpiece. Any of the small electronic or electromechanical buzzers available may be pressed into service. Dick Smith stocks one, catalogue No. L-7009, while Tandy list several suitable types, such as catalogue Nos. 273-004 or 273-060. Pressing either 'call' button will sound both buzzers.

Each 'talk' switch should be a spring return-type. If you can arrange to hang the handset off them, so much the better.

COMPARE OUR PRICES!

Power Transformers

Bulk purchase of new, best quality mains transformers used in H and K chassis AWA-Thorn colour TV sets.

H Primary: 0,120V,125V, plus 0,120V,125V for 240V, 250V operation.
H Secondary: 0,120V 1 Amp plus 6V 1 Amp.
K Primary: 0,240V,250V
K Secondary: 0,105V 1.3 Amp plus 6V 0.9 Amp plus 12V 0.25 Amp.

240V AC INPUT

$9 PLUS $2 EXTRA POST.

CLEARANCE SALE

CB XTALS 27.880, 27.890, 27.900, 27.910..pr$1.50
TTL 7406......10for$2.00
TTL 7420......10for$1.50
TTL 7473......10for$4.00
TTL 7490......10for$4.50
5mm Red LEDS..10for 0.90
5mm Bezel for LED.ea0.05
3AG Fuseholders- in-line plastic......10for$2.00
PCB Fuse-Clips.8for 0.50
Philips 2"8Ω Tweeters 20W power........2 for$4.00
4" Mid-range 8Ω 20W power, imported Novik ea.$4.00
6"x4",4"sq. 15Ω..ea.$3.00
Record Cleaner Arm, with cleaning kit...ea.$2.00
12V 100mA mini-globes, wire leads...10for$1.00
Neons NE-2 90v 8for$1.00
DPDT slide switch.ea0.25
DP3T slide switch.ea0.30
DPST rocker " .ea0.30
3 pos 10Amp rotary sw, with white knob..ea0.50
4 pos Oak rotary switch, with On-Off......ea0.50
0.1uF 250v poly 12for $1
0.22uF 100v " 10for $1
0.015uF 200v " 15for $1
0.068uF 400v " 10for $1
0.047uF 200v " 10for $1
0.022uF 200v " 12for $1
0.15uF 250v " 10for $1
0.68uF 250v " 4 for $1
0.056uF 1KV " 3 for $1
0.47uF 400v " 4 for $1
0.1uF ceramic 12for $1
0.047uF ceramic 15for $1
1000pf ceramic 20for $1
100pf 25v styro 20for $1
15uF 35v tantalum ea0.30

POWER TRANSFORMERS

DOUBLE BONUS OFFER!

2 for 1

FOR PERSONAL Shoppers ONLY

12v-0-12v 500mA

MAINS 120v PRIMARY

PRIMARY CAN BE IN SERIES (240v) SECONDARIES CAN BE SERIES/PARALLEL

$1 FOR 2

Outputs of 12V, 24V, 36V, or 48V at 500mA, 12V or 24V at 1A are possible!

Philips TRIPLERS

FOR COLOUR TV
BEST QUALITY
SIEMENS/VARO

$9

As used in Pye, Philips, Kriesler and most German colour TV's.

EHT Trans

Brand new Philips EHT Transformers, NOW REDUCED $1.50

$4 NT3100 NT3101 NT3122

YOKES FOR AWA COLOUR TV's

MANUFACTURERS EXCESS STOCK!
Brand new picture tube deflection yokes for AWA 63cm H chassis and 53 cm K chassis TV sets.

sale price! at $8 EA

12V DC ROTARY SOLENOID STEPPING SWITCH

U.S.A. Made!

$19.99 12 POSITION, SINGLE POLE, SHORTING.

SHOP EARLY FOR XMAS!

STOP THIEF!

Ultra-sonic BURGLAR ALARM $49

WAS $65, NOW SAVE $16

Ideal for your home, office or shop, the General Electric ultra-sonic alarm is small, self-contained and inconspicuous. The beam detects at up to 30ft, and emits a very loud, shrill tone which can be heard for over 100 metres A 5-digit push-button selector cuts off the alarm which resets after 5 mins, and a 35second test and exit delay and instant "ON" or delay "ON" (10secs) are included.

HEAVY DUTY SCR's

200v...25A..$1.00
100v...60A..$5.00
200v..110A..$5.50
LOTS MORE AVAILABLE AT THE RIGHT PRICE!

RECTIFIERS

100v....60A..$5.00
50v...250A..$6.00
200v...250A..$8.00

IC's

"SWEEPINGS OFF THE FACTORY FLOOR"

Approx 100 ASST. FOR $11.50

1000 for $100

MOST SOPHISTICATED CAR ALARM

With the FLASHING YELLOW Light

USUALLY $99.50

$85

Large, lighted push-switch for ALARM ON, ignition key deactivate for ALARM OFF. (No hidden switches). Flashes turn indicator lights and pulses HORN to gain attention when operating. Latest battery voltage-drop sensing design with custom designed IC circuitry made for "PROTECT-A-CAR" Alarms.

"AS IS" SALE

We have a large quantity of appliances which are shop-soiled and cannot be sold as "NEW". There may be slight faults, so we are selling them "AS IS". A bargain-hunters paradise!
Clock-radios from $10, radio/cassettes from $15, small radios from $2, TV games etc from $11. cassette recorders from $10, record players from $12, remote control toys, torches, car vacuum cleaners, etc.

Speakers

8" WOOFER 8Ω 25W RATING
55-5KHZ 7.50

5" MID-RANGE
500-12KHz 5.95

3" TWEETER
5KHz-18KHz 4.50 GREAT VALUE!

CROSSOVER NETWORK
800Hz, 5KHz 6.90

BOXES TO SUIT

ABOVE, READY-MADE $17 EA

Telescopic AERIALS for TV's

Both pivot and swivel

As used by Philips

A 170 to 875mm POPULAR TYPE $1.95
Pack of 10 $16

B 250 to 920mm HEAVY DUTY $2.75
Pack of 10 $22

CO-AXIAL SWITCH

SPDT rotary-action switch for HF/VHF use. Fully shielded, Brit. made.

$19

AM/FM Radio Portable

BATTERY/ELECTRIC
Were $17.95

$12

MINI-TOGGLE SWITCHES

A. ON-OFF standard 90¢
B. ON-(ON) momentory 80¢ SPDT
E. (ON)-OFF-(ON) mom. 70¢ (3P)
F. ON-OFF standard $1.35
G. ON-(ON) momentory $1.00 DPDT
J. (ON)-OFF-(ON) mom. 90¢ (6P)

ex-computer gear HEATSINKS

HUGE RANGE AVAILABLE!

3"x4" WITH 1xT03 TRANS.$2.50
6"x4" WITH 2xT03 TRANS.$3.00
9"x4" WITH 4xT03 TRANS.$4.00
12"x4" WITH 5xT03 TRANS.$5.00

WE HAVE LOTS MORE INCLUDING REALLY HEAVY DUTY 12"x8" FOR 10xT03 TRANS. ($12.00), PLUS OTHERS SUITABLE FOR LARGE POWER SUPPLIES AND POWER AMPS - EVEN SMALL ONES, TOO!

SWITCHING REGULATOR POWER SUPPLIES

5 VOLT DC, 60 AMP

240V AC Input
Not tested, but assumed working.

$45

EX-COMPUTER GUARANTEED FANS

115v 3" $15	115v 5" $15	240v 5" $18
82x82x40mm	130x130x30mm	130x130x40mm

THIS MONTH ONLY 2 FOR $15

250v 6" $17	220v 7" $19	220v 7" $21
166mm diam.	185mm diam.	185mm diam.

POWERFULL HIGH VELOCITY BLOWERS
SINGLE OR TWIN SQUIRREL-CAGE 240v BLOWERS $24 LARGE HEAVY-DUTY 240v FANS 200x200x100mm

CIRCUIT BREAKERS

Ideal for all Power Supplies
1A, max 50v DC

$3

Small ex-computer circuit breakers with standard 10mm pot-hole mounting and ON-OFF toggle switch action. Cutout at 1.25A, up to 50V DC operation.

$49 PAIR 15W 8 inch 2 WAY speaker systems at bargain prices!

Famous maker HI-FI SPEAKERS, slightly shop-soiled but otherwise A1, as used on $400-$500 hi-fi systems. We were selling these at $79 PR, but now we need the warehouse space, so, out they go! Overall size 680x 295x230mm deep, weight 20 Kgm. Do not include P/P, send "FREIGHT TO PAY" by road.

THE MODERN PHONE DIALER

- EASY INSTAL IN MINS
- ONLY 3 WIRES
- IVORY COLOUR
- FULLY G'TEED
- LED INDICATOR
- LAST NUMBER MEMORY REDIAL if called number is engaged

Direct replacement for rotary dial. Not approved by Telecom currently.

$29.99

BONUS: BUY 9, GET 1 FREE!

TV PCB'S

From AWA, these new circuit boards have over 80 parts incl. 8 trans. (2SC1014, 2SC711, 2SA673, 2SA628, 2SC620), 10 diodes, caps, resistors, trimpots, etc. GREAT VALUE HERE!

$1 EACH
10 FOR $8.00

Push-Button TUNER BOARDS

Comprises 2 boards, one has 8xDPDT push-button switches, similar to Isostat - the other has 8x100K multi-turn trimpots with 3 position band-change switches. LTD. QTY.

$3 EACH
10 For $25.

NEW AC VOLTAGE DETECTOR

POCKET MODEL NON-CONTACT

Easily locates wiring in walls, open circuits, identify actives.

$12

☐ Cheque ☐ Postal Order ☐ Charge to my Bankcard Account
(Please don't send cash)

Account No. 496

Expiry Date
Cardholder's Signature

Name
Address
Postcode

PRE-PAK electronics

569-9797
PACK/POST: ADD 10% ORDER VALUE

SHOP: 1A WEST ST. LEWISHAM NSW
MAIL: P.O. BOX 43, CROYDON NSW 2132

24HR PHONE ORDERS
PHONE OR MAIL ORDER BY bankcard

- QUALITY PRODUCTS AT LOW PRICES
- SAME DAY DESPATCH OF MAIL ORDERS
- MONEY REFUNDED IF NOT SATISFIED
- GIVE US A TRY-WE WANT YOUR ORDER!

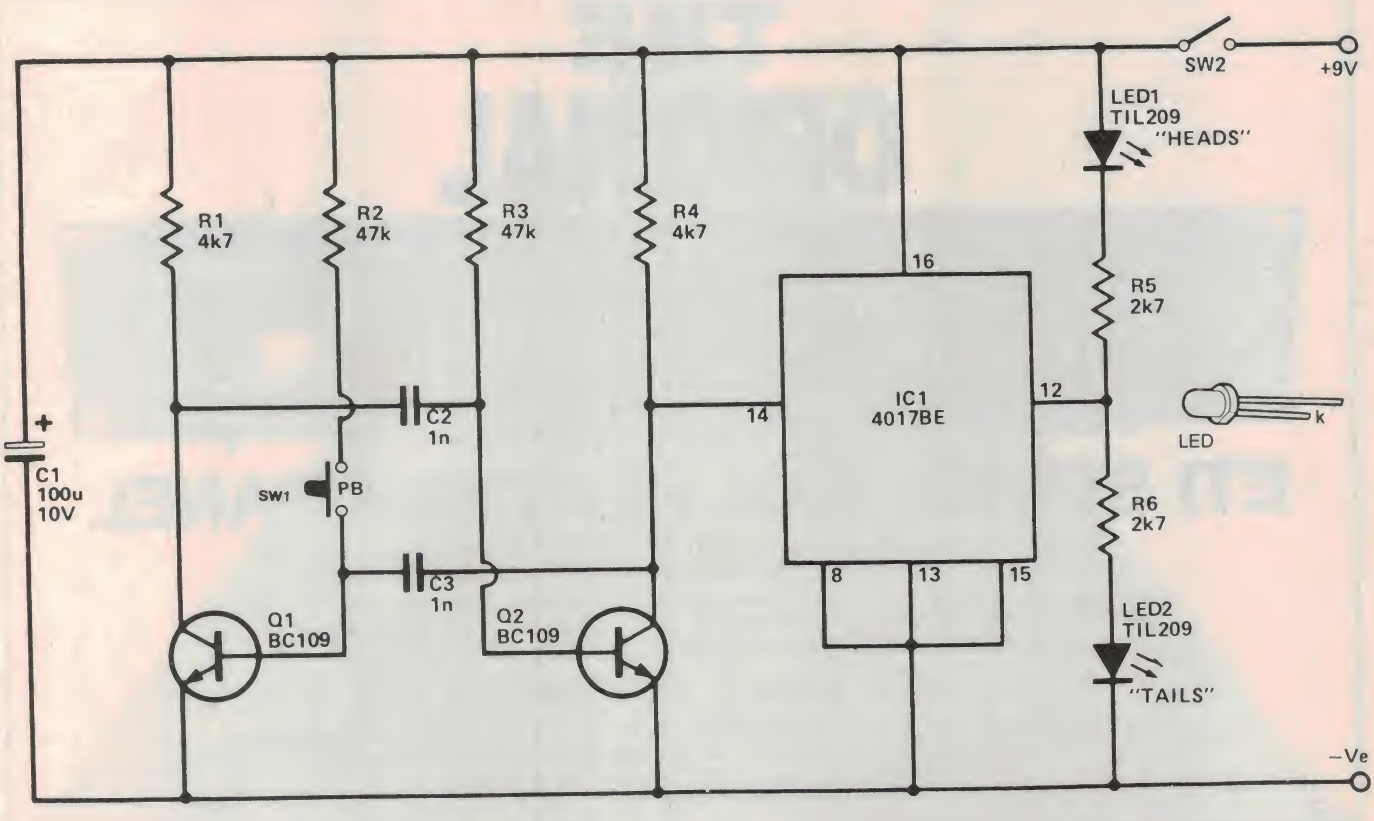
"Heads or tails" — electronic decision maker!

THIS SIMPLE novelty circuit is designed to electronically simulate the tossing of a coin; randomly producing a 'heads' or 'tails' output. The output of the unit is displayed on two LEDs, one being marked 'heads', and the other being given a 'tails' legend. The unit has a pushbutton switch which is briefly pressed in order to 'toss the coin', and only one of the LEDs will be switched on when this switch is released, indicating the 'decision' of the unit.

The circuit uses Q1 and Q2 in what is virtually a standard astable multivibrator circuit. The only deviation from the standard configuration is the inclusion of pushbutton switch SW1 in the bias circuit for Q1. As the circuit stands there is no bias to Q1, and the circuit therefore fails to oscillate. However, if SW1 is operated the circuit can function normally. A roughly square wave output is then produced at the collector of Q2, and the specified values give an operating frequency of many kilohertz.

This square wave output is fed to a 4017 divide-by-ten circuit, which is used here effectively as a form of bistable circuit. After each five input cycles, the output of IC1 (pin 12) changes state, and while the clock oscillator is functioning, this output therefore changes state a few thousand times per second. LED1 and LED2 are the two indicators, and are driven from the output of IC1 via current-limiting resistors R5 and R6. When IC1's output is low, R6 and D2 are effectively short circuited by the output stage, but D1 will be switched on. Conversely, when the output is high D1 and R5 are short circuited, and it is D2 that is switched on. While the oscillator is running, both LEDs appear to be switched on since the switching action is far too rapid for a human observer to perceive. When SW1 is released and the oscillator stops, IC1 will stay in whatever output state it happened to have at the instant the oscillator stopped. There is, of course, no way of predicting which state this will be, and which of the LEDs will be switched on. It is purely a matter of chance whether the unit indicates 'heads' or 'tails'.

SW2 is the on/off switch. The current consumption of the circuit is only about 5 mA.




we invite you to join
EVEREADY
light-up holiday bonanza
WIN
ONE OF THESE VALUABLE HOLIDAY PRIZES
3 Coleman Camper Trailers ($4440 Value Each)
20 Coleman 2-Person Tents ($95 Value Each)
20 Shakespeare SIGMA 2200 Reels ($47.50 Value Each)
100 Shakespeare Deluxe 8' Fishing Rods ($34.50 Value Each)
FREE
EVEREADY TORCH OR LANTERN WALL BRACKET
LIMITED SUPPLIES
ORDER YOUR HOLIDAY NEEDS NOW
BMX JERSEY SHIRT
T-SHIRT
SAILING/SPRAY JACKET
FISHING JACKET
HURRY! COMPETITION ENDS 4th JANUARY 1982
(Commencing date 1st November 1981)
LIST OF PRIZE WINNERS WILL BE PUBLISHED IN THE PUBLIC NOTICES SECTION OF THE AUSTRALIAN NEWSPAPER IN ALL STATES ON 18th JANUARY 1982.
GET YOUR ENTRY/APPLICATION FORM AT PARTICIPATING RETAIL OUTLETS.
TOP 781/2 — B&W
'EVEREADY' is a registered Trademark of 'Union Carbide Australia Limited'

LETTERS

Dear Sir,

I think there is an error in the design of the ETI-1501 Negative Ion Generator (April '81, p. 30), or at least a contradiction in your explanation of how it works.

Firstly, in your accompanying feature article on negative ion generators (pages 15 to 21, same issue), on page 17 you give the circuit of a commercial negative ion generator, showing a 10-stage 'Cockcroft-Walton' voltage multiplier-rectifier which works on the principle of multiplying the peak-to-peak value of the ac mains input. As the peak-to-peak value of the mains is about 680 V, the rectifier would give nearly 7 kV, which is nothing like the 3 kV you say is applied to the emitter head in Figure 2, page 16. It seems, then, that the voltage multiplier-rectifier only multiplies the peak value of the input.

Looking at the ETI-1501 project, the circuit on page 31 shows the same sort of rectifier, only it has six diodes, not ten. It should only produce about 1.8 kV. On my unit, which I built from a kit, I can measure about 1 kV with my multimeter. Taking into account the loading effects, this seems to confirm my suspicion that the rectifier in the project only produces 1.8 kV.

I looked up the rectifier circuit in a textbook, which says that it multiplies the peak of the ac input voltage, and I asked my electronics lecturer at tech. and he says there seem to be insufficient diodes on the high voltage board of the ETI-1501 to produce the voltage specified (3 kV).

How do you get 3 kV? Can you enlighten me?

W. Dillon
Melbourne, Vic.

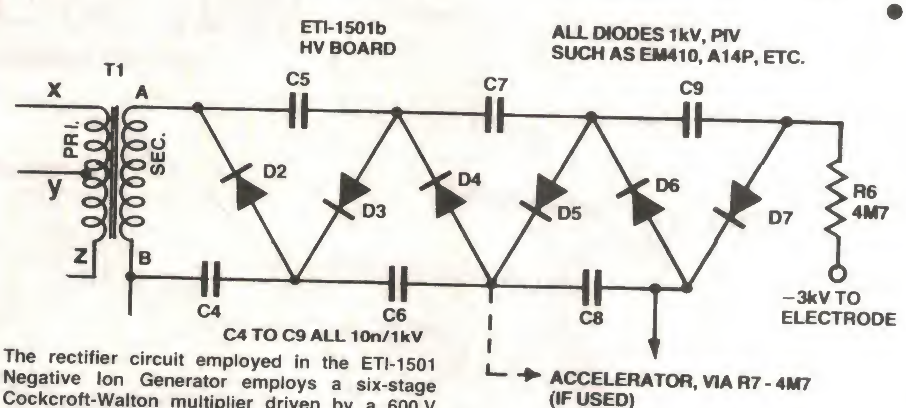
There is neither a mistake nor a contradiction in the way in which the ETI-1501 works and how it is explained. However, there is some confusion arising, as you are comparing the circuit of the commercial ion generator on page 17 of the April issue with the circuit of our project on page 31. The commercial ion generator employs a voltage multiplier driven by a sinusoid — the mains. This type of rectifier multiplies the **peak** *value of the ac input. The peak value of the (nominal) 240 V mains is about 340 V. The 10-stage multiplier rectifier on page 17 will thus produce about 3.4 kV. Our project, page 31, employs the same sort of rectifier-multiplier, but it is driven by a* **square wave** *(1:1 duty cycle) from terminals A-B of the transformer secondary (T1). The peak value of the square wave at A-B is about 600 V. Thus the six-stage Cockcroft-Walton rectifier-multiplier produces around 3-3.5 kV. The proof of this is in the measurement. If you use a high impedance input meter to measure between terminal B and the electrode connection you will get the predicted voltage. We measured it, and we did. Note that the peak and the peak-to-peak value of the square wave at the secondary of T1 are the same. To properly measure the voltage at the anode of D7 you will need a meter with an input impedance of at least 10 M.*

The voltages quoted are **not** *specifications but measurements.*

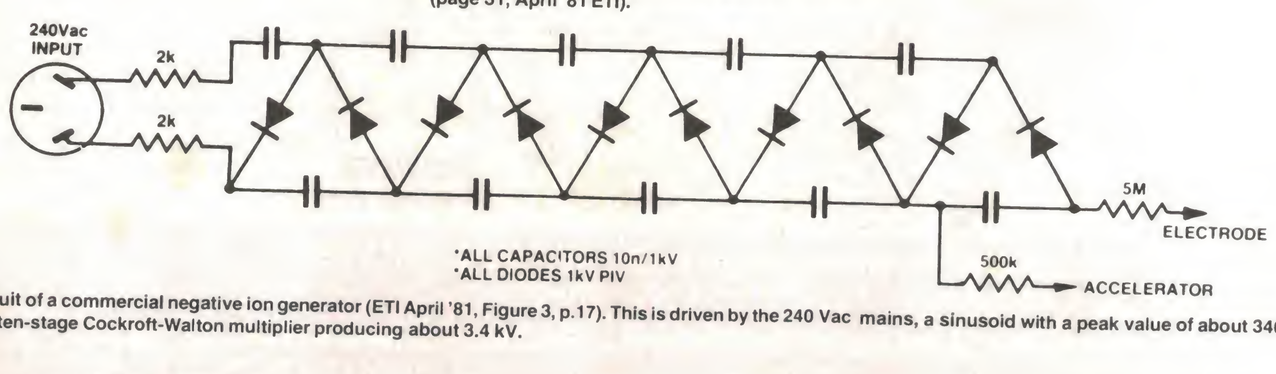
Most texts, when explaining the operation of voltage multipliers (and rectifiers for that matter) fail to mention that the results obtained are predicated on a sinusoid input.

In retrospect, we should have explained the operation of the rectifier in more detail, as it is employed here in an unusual application and a number of readers wrote puzzling about it in the same way you did. I trust you have now learned a little more about electronics.

Roger Harrison
Editor ETI



The rectifier circuit employed in the ETI-1501 Negative Ion Generator employs a six-stage Cockcroft-Walton multiplier driven by a 600 V peak square wave, producing around 3-3.5 kV (page 31, April '81 ETI).



Circuit of a commercial negative ion generator (ETI April '81, Figure 3, p.17). This is driven by the 240 Vac mains, a sinusoid with a peak value of about 340 V, the ten-stage Cockroft-Walton multiplier producing about 3.4 kV.

AMPLIFIER SENSATIONS!

Even our jaded and cynical staff are amazed. We have been absolutely swamped with orders for the new ETI 5000 Pre-amp and Power Amp.
One day all high quality Hi Fi amps will have MOSFET finals. If you can't wait until then why not look at this great ETI design?
We call the power MOSFET's "Bomb Proof". By this we mean that it is most difficult to destroy them by fair means or foul. Because they do not suffer from thermal runaway, (as bipolar transistors do) you don't need complex distortion - producing circuits to protect them. The MOSFETs don't suffer from secondary breakdown either.
The Pre-amp is now available (at last!) and we have had the opportunity to have a close look at it too. We believe that like the power amp, it offers the maximum performance available from current technology.
If you are a perfectionist or are just not happy with what you have got now this system could be for you. You owe it to yourself once in your lifetime to bestow upon yourself "the best".
In the case of amplifiers, this is it.

5000 POWER AMPLIFIER

The Jaycar kit of this project is being continuously updated in quality so that the constructor will benefit. We now supply metal film 1% 50ppm resistors in place of carbon film types. All Aluminium hardware (including heatsink bracket) is now anodised in black. (Incidentally there has never been a problem with instability with Jaycar kits. We have ALWAYS used high quality capacitors).
The original square-section chassis bars are used. And then there is the Superfinish frontpanel!

Specifications: Power Output — 100 watts r.m.s. into 8 ohms x2 Frequency Response — 8Hz to 20kHz, +0 —0.4dB. Noise — 116dB below full output. Input Sensitivity — 1V r.m.s. for 100 watt output. For full specifications see magazine article on this amplifier.

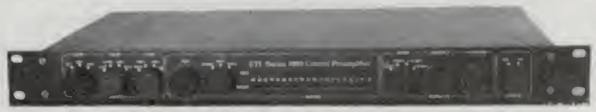
Ref: ETI Jan — April 1981

EXCLUSIVE!!!
- Metal film 1% resistors used
- All Aluminium panels now anodised
- Original dsign chassis bars used
- Heavy gauge extruded section heatsink bracket
- prewound output chokes
- Flux shorting straps on transformers
- And then there's the Superfinish heatsink

$289
+ $15 freight

5000 CONTROL PREAMP

Control being the operative word. With this preamp you are in TOTAL CONTROL.
With 3 x phono inputs and 5 OTHER input facilities, you can dub to TWO (2) tape decks — say one cassette and one reel-to-reel. Once again we have used 1% 50ppm metal film resistors throughout — even where not specified by Dave Tillbrook.
For further information see the specifications summary below:

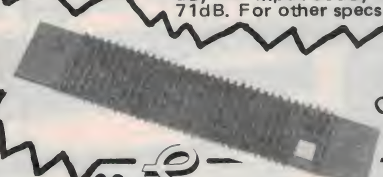


Frequency Response — 15Hz 130kHz @ +0, —1dB. Distortion 1kHz - 0.003% on all inputs. S/N Ratio — high level input 92 dB, MM input 86dB, MC input 71dB. For other specs see mag.

EXCLUSIVE!!!
- English "Lorlin" switches used
- Metalwork exactly as per project
- description
- Special Nylon grommets used to insulate jacks
- Metal film 1% resistors used
- Specially imported solid Aluminium knobs
- FREE! Pair of GOLD PLATED RCA line plugs for low noise M.C. input

only $245
+ $10 freight

Parts available separately



ONLY $49.50

*Super Finish * * * * The Jaycar Front Panel

SUPERFINISH front panel. Special fine grain Aluminium machined, drilled and tapped and finished in special low-gloss black enamel. This panel stands up to a close inspection.
" OR $299 TOTAL WITH THE 5000 POWER AMP"

ETI485/JAYCAR 2010 EQUALISER NEW MkII model with QUAD-FETs

We have upgraded the performance of this popular kit by taking advantage of the new high technology J-FET input op-amps.
The MkII Stereophonic Equaliser now has a much lower noise floor, better T.I.D. performance due to the higher slew-rate of the J-FETs. Lower harmonic distortion also prevails.

DUAL 10 — BAND!!

ONLY $129

+ $5.50 P & P

FEATURES:
- New low noise J-FETs throughout - replacing Bipolar OP Amps
- Lower noise floor
- Lower harmonic distortion
- Lower transient intermodulation distortion
- Completely new assembly instructions
- Standard 3½" x 19" rack cabinet (prepunched) supplied
- Heavy guage anodised silk screened front panel

1/3 OCTAVE 28 BAND EQUALISER NEW MkII model at NO EXTRA CHARGE!!

We have made the same changes to the 2801 Equaliser but we have absorbed the EXTRA COST! Professional style bright yellow slider covers are now standard also.

+ $5.50 P & P

still only $198

Jaycar

NOTE! NEW SHOP HOURS
Mon - Sat 9am — 5.30pm
Sun - 10am — 2pm
Open Thursday night until 8pm.

VISA

380 Sussex St Sydney 2000
Ph. 2646688 Telex 72293
Mail Orders To: Box K-39 Haymarket 2000

Jaycar Dealer: D.E.S. Electronics 157 Brisbane St. Dubbo Ph. 829355
See our other advertisements for post and packing charges

LETTERS

Dear Sir,

Could you please supply circuits for the following: 240 V mains electric fence and a portable cattle prod. I understand that you are not responsible for their construction and any information that you supply would not obligate you in any way.

J. Adams,
Sheffield, Tasmania.

Unfortunately, we cannot undertake to supply information or circuits on equipment or projects other than what we have published in the magazine. We trust that you, and other readers, would understand that our technical staff is primarily occupied on research, development and production of projects and technical articles for publication in the magazine and we cannot afford to seek out or develop circuits from other sources for individuals' applications.

Roger Harrison
Editor, ETI

Dear Sirs,

Could you please advise if you ever published information about using the **ETI-681 Programmable Character Generator** as an (x, y) graphics plotter? One paragraph in the original construction article (ETI June 1980, p.67) said "... more about this later ...", but the article stopped at only describing the hardware.

I have been thinking about ways of using it to achieve (x, y) plotting and vector graphic drawing ((a, b) to (x, y)) but do not have the hardware on which to experiment yet. In fact I want to feel reasonably sure it will do what I want before I start assembling an S100 system based on the ETI/DGZ80 + 640.

My approach is to work up a machine language routine to convert the (x, y) coordinates to (CHR, LINE, column, row) co-ordinates to specify which 'character' and which dot, then check the 'characters' already programmed to see if one fills the bill, and if so to address the relevant VDU RAM cell to it, or if not to program a new one and address the VDU cell to it. I haven't figured out a way to do the vector graphics yet. I'm hoping you have done some work on it as I would hate to tax my brain duplicating someone else's headaches!

An incidental enquiry: I have not yet been able to get a clear statement from a kit supplier as to whether the **DGZ80** will operate **dynamic memory** boards such as the TCT. The description in the original article does not touch the subject. Can you say yea or nay?

Many thanks for a continuing stream of interesting material in your magazine.

G.N. Harrod
Indooroopilly, Qld.

We have spoken with Craig Barrett, designer of the ETI-681 PCG concerning follow-up articles on using this versatile S100 board, and he is preparing article(s) which we hope to publish early next year.

There is no ostensible reason why the ETI-680 (DGZ80) S100 CPU board cannot be used with a suitable S100 dynamic RAM card.

Dear Roger,

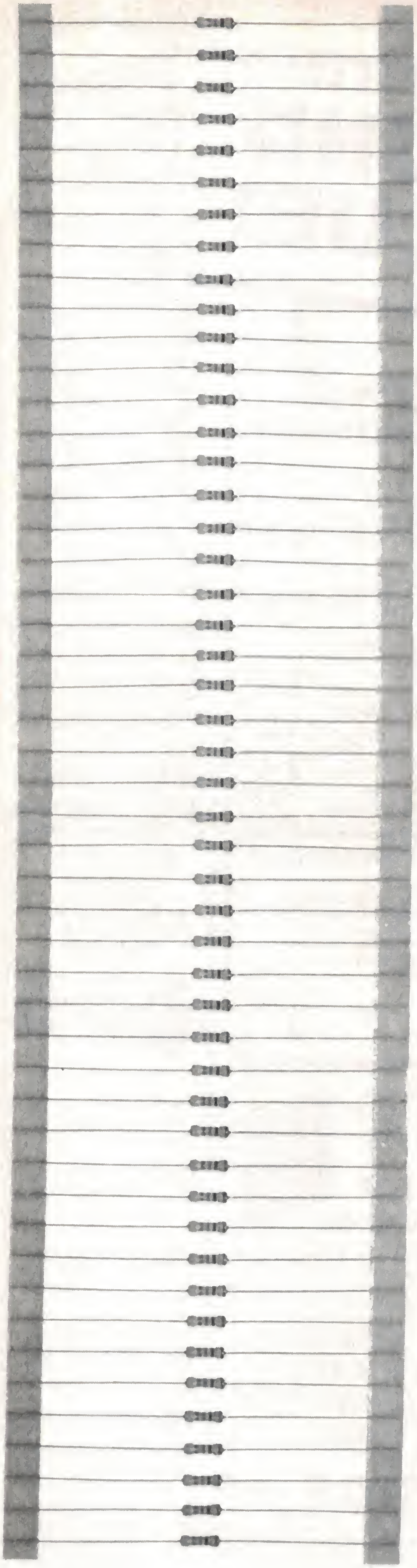
I wish to take this opportunity to congratulate you on your excellent article, "A good joint is hard to find ...".

Whilst many of the experienced readers may think that this subject is 'done to death', we here at Jaycar feel that not enough attention is paid to soldering by the average enthusiast. Despite years of practice most people still regularly produce dry joints. As a matter of fact, 90% of the faults in correctly wired kits (in our opinion) are due to poor solder joints.

Perhaps as a follow-up to this article you could do a small article on the art of correctly soldering and terminating screened audio cable. With the tremendous interest in the Series 5000 preamp we feel that such an article would be certainly justified!

Finally on another note, I thoroughly endorse the comments you made in your editorial in the October issue. Tax on most hobby electronic components is now a staggering 30%, thanks to the latest budget. Inevitably these increases will pass on to the hobbyist. As you said, the cost of interest in electronics will rise, thus dampening motivation. I should have thought the Government would have encouraged motivation (especially in young people), not discouraged it.

G.N. Johnston
Managing Director, Jaycar



Shoparound

THIS PAGE is to assist readers in the continual search for components, kits and printed circuit boards for ETI projects. If you are looking for a particular component or project — check with our advertisers if it is not mentioned here.

To satisfy enthusiastic Victorian customers, Dick Smith Electronics has opened another store, his fourth in Melbourne. Situated at 260 Sydney Road, Coburg, it boasts "everything you would want in electronics". Dick urges you to call in and meet the manager, Paul Gursanscay, and take advantage of "the many bargains and direct import prices". Go and bash Paul's ear – tell him to stock more ETI kits!

ETI-660 Computer

No doubt most readers have found that this project is widely stocked as a kit. For those using components on hand and shopping around for other parts to save money, pc boards are readily available — if you're not making your own. If you are making your own then artwork is available directly from us. Send a large (at least 300 x 250 mm) stamped, self-addressed envelope to ETI-660 PCB, ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011. If you don't want to make your own, pc boards may be individually available from Rod Irving Electronics and Ellistronics in Melbourne, Radio Despatch Service and RCS Radio in Sydney and Jemal in Perth.

The 400 ns delay line comes from a Pye TV, model no. T29, and its part no. is 157-507-38. You may be able to obtain it through Philips Service centres, or some kit and component suppliers may sell it separately. Other 400 ns delay lines may be pressed into service — the only requirement is the 400 ns delay.

To get an EPROM programmed ('blown' is the jargon) you'll have to seek out a computer hardware firm that runs an EPROM-programming service and see if they can do the job for you. Again, some of the kit suppliers may be able to supply you with a ready-programmed EPROM for the project. The program listing is given in the construction article.

The 8 Vac/1 A plugpack we used came from Ferguson Transformers and is their model no. PPB8/1000. You can use a conventional transformer if you wish, as suggested in the construction article, but it will have to be mounted out of harm's way along with properly organised and terminated mains wiring.

Housing the project is not a problem and you can suit yourself — anything from screwing the pc board and modulator to a suitably sized piece of wood to putting it all inside a nice plastic or metal case — or you can make up a case to our plans. Only simple tools are necessary if you follow the latter course. Case assemblies made to our design will be available from several suppliers, we understand.

The ICs are generally widely available, or should be by the time this is published. The 1802 and 1864 chips are made by RCA and distributed in Australia by AWA Microelectronics Division, 348 Victoria Rd, Rydalmere NSW 2116. (02)638-9022.

ETI-158 Low Ohms Meter

There is little specialised about this project so readers should have no difficulty with parts availability. Even 1% and 2% tolerance resistors are common components these days.

For terminals we used two two-way quick-connect speaker terminals. These are convenient as they have one red and one black terminal each so that polarity is automatically determined. We obtained ours from Dick Smith and they're listed as catalogue no. p.1764. However, numerous similar types are widely available.

The spring-loaded toggle switch is not a common item but can be found with a little digging in stores that carry generally a wide range of components. We bought ours at Radio Despatch Service in Sydney, but as it is a C&K type suppliers who carry C&K switches may have it in stock or be able to obtain it.

A variety of common meters may be used and we have provided artwork for scales for three common types — the Minipa MU-45, the SEW ST65 and the University TD66. We understand University Graham Instruments will be making meters available with our scale design included. Check with your supplier.

Scotchcal front panels and meter scales should be available from the usual suppliers — All Electronic Components and Rod Irving Electronics in Melbourne and Radio Despatch Service in Sydney. Jemal in Perth may have supplies, too.

We used a collet knob for the range switch, but any suitably sized pointer knob will suit. Collet knobs from Associated Controls and C&K are now quite readily available from numerous outlets, so you should have little difficulty getting a knob to suit.

While multiturn horizontal mount trimpots are reasonably common, not every supplier stocks them. Check your favourite supplier first.

The Jiffy box we used came from Altronics in Perth and it features board guides that allow the board to 'snap in' position. It was a type no. H0102 and measures 196 x 113 x 60 mm. As Jiffy boxes are legion, we don't think you'll have much trouble finding one to house your project.

Printed circuit boards should be readily available. In Perth, Jemal; in Melbourne, Rod Irving Electronics, Ellistronics and All Electronic Components; in Sydney, Radio Despatch Service and RCS Radio.

ETI-596 Noise Gen.

If you have any problems with this, then you *really* have problems! All components are widely stocked and the pc board should be obtainable from the previously mentioned suppliers.

Intersil ICs

Over the past year or so we have used some of the unique chips from the Intersil range — such as the 7106 dpm chip and LAD204 LCD display featured in the ETI-572 pH Meter published last December. R&D Electronics, the sole Australian representatives for Intersil, have appointed All Electronic Components of 118 Lonsdale St, Melbourne, as a distributor for their products.

So if you are interested in Intersil ICs, see A.E.C.! ●

NSW Police call on WICEN again

Following an unsuccessful search and rescue attempt to find a light aircraft that disappeared on 9 August (see this column, October issue), NSW Police again called on WICEN to assist in a search for the aircraft late in September.

The Cessna aircraft, VH-MDX, is believed to have gone down in the Barrington Tops area north of Newcastle, regarded as the most heavily forested, rugged and inaccessible part of NSW.

Although the search failed to find the aircraft, it proved that specialised volunteer groups can work together and with the statutory authorities in a major operation. 452 men and women from the Police, State Emergency Services, Army Reserve, Forestry Commission, Hunter District Water Board, National Parks and Wildlife Service, Hunter Valley 4x4 Club and many Volunteer Rescue Association squads were involved.

The Wireless Institute Civil Emergency Network was activated by the NSW Police. Amateurs came from Hunter Region, Central Coast Region and Taree WICEN to provide radio links between the Police Control Centre at Dungog and various groups of searchers. Amateurs manned field stations deep in the Barrington Tops for up to 52 hours, literally bedding down next to their radios. Operators had to provide and establish portable stations on 146.0 MHz, 146.9 MHz (repeater 6900), 7.05 MHz, 3.6 MHz and 439.0 MHz. Radios on the VRA rescue frequencies were provided by the squad involved. WICEN also provided a TV crew to film SES and WICEN personnel in the operation, for training purposes.

After seeing the rugged area they were required to search, the Police Air Wing Chief Pilot requested a portable on the WICEN frequency in case they had to make a forced landing. This was provided but fortunately was not needed.

When one seemingly undeliverable message was offered to the other services involved, a comment was heard: "Give it to WICEN, they can do anything"; the message was delivered.

Amateurs operating in the search area were VK2s — BVO, YUP/PEP, KAL, BJC, KBN, DCW, NZW, AVO, DVL, GL, BSC, ZED/PED, BUL, ZRT, BVT, BVI, BVQ, YCB, BMK, YFJ/NLO, VWD, BRF, ZVF, NUM, AOH, BMM, KCS and DKP.

VK2BOT and VK2BGF operated in Taree, VK2TS and VK2BUQ manned stations in Gosford, and VK2NL, DHG, NFF, NWA, AGS, DI and DEX were operating in Sydney.

A special thanks must go to Ray Wells, VK2BVO, Central Coast Region WICEN co-ordinator, Max Francis, VK2BVO, North Coast Region WICEN co-ordinator, and Charles Withers, VK2BVI, Taree local WICEN co-ordinator, for their support in this large operation.

Kim Piper, VK2DKP
Hunter Region WICEN Co-ordinator

Roma Piper, VK2NZW, hands a 2 m transceiver to Police Chief Pilot Peter Leslie, who requested it for emergency communications in case of a forced landing. Photo by Mike Richter, VK2BMM.

27 MHz marine SSB transceiver

Recent revision by the Department of Communications of the 27 MHz On-shore Boating Radio Communication Service now provides for the use of SSB transmission on 27 MHz.

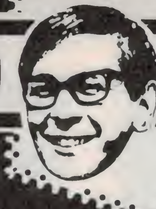
Dick Smith Electronics now have available a fully approved AM/SSB transceiver which meets the new Government requirements and costs only $249.

The Stalker IX transceiver, Cat. No. D 1715, comes fitted with the maximum number of allocated channels and provides for further expansion to 12 marine frequencies. In addition, the set complies with the boating industry list of recommended features, with automatic distress frequency surveillance on unused channels and AM transmission on 27.88 MHz.

Standard features include a public address facility, fully variable microphone gain, RF gain control for overload protection, and receiver clarifier control. The unit is supplied with mounting bracket, power cord, microphone bracket and comprehensive instruction booklet.

To page 97

AMATEUR RADIO



HUGE SCOOP PURCHASE!

SAVE ON THE 'NO FRILLS' FT107

ONLY

$850.00

WHY PAY $1278?

YOU REAP THE BENEFIT

Here's your chance to up-date to one of the best transceivers in the world, at a true bargain price!

Dick Smith has just made a scoop purchase of the entire manufacturer's stock of the famous FT107M transceivers - at an incredible discount.

They have all the outstanding features that have made the FT107M Australia's most popular top-line transceiver, and include all of the current legal amateur bands. (They don't have the new WARC bands included - but why pay hundreds of dollars more for bands we may NEVER get to use?)

Hurry: stocks are strictly limited - and as we bought the entire manufacturer's stock, this offer can NEVER BE REPEATED!

D-2863

SPECIFICATIONS:

Frequency coverage: 160, 80, 40, 20, 10
Modes of operation: LSB, USB, CW, AM, FSK
Input power: 240W DC (SSB), 80W DC (AM, FSK)
Sensitivity: 0 25uV for 10dB S/N (SSB/CW/FSK), 1uV (AM)
Selectivity: 2.4kHZ (-6dB), 4kHZ (-60dB) SSB, cont variable from 300 to 2400Hz
Carrier Suppression: better than 40dB
Spurious radiation: better than 50dB below rated output
Power requirements: 240V & 13 5V supplies built-in.

THE MANY BENEFITS OF BUYING YAESU FROM

DICK SMITH

- *We sell more Yaesu than anyone else: so we have the best stocks, at the best prices (tell us if we're wrong!)*
- *We have the largest service centre: if something does go wrong with your Yaesu, we can fix it fastest!*
- *We honour Yaesu's 12 month guarantee - beware of others who may offer you only a 90 day warranty.*
- *Dick Smith Electronics have over 22 stores throughout Australia - plus over 200 approved re-sellers. You're never far from friendly help.*
- *We know amateur radio - we have 32 licensed amateur radio operators on the staff including Dick Smith & Ike Bain the Managing Director.*

AND WE GIVE YOU A FULL 12 MONTH GUARANTEE!!

FINANCE TO APPROVED PERSONAL CUSTOMERS OR USE YOUR BANKCARD

CHECK THESE OTHER GREAT DEALS

Mobile or base

WARC

D-2869

FT707 Yaesu has used the 'state of the art' technology & put it into such a tiny package. Yes, it's the brilliant FT-707. This little wonder contains all the outstanding features that most big rigs lack. It's a full power, all HF band (inc. WARC) multi mode transceiver. You get digital readout, LED S/power meter, push button operation . . . all the things the amateur needs for safe reliable operation. You've waited a long time for a rig like this, so take the splurge now, it's well worth the money.

ONLY $795

Antenna Coupler

Get the most from your FT-707, use the Yaesu FC-707 antenna coupler & ensure your transceiver always delivers the power it should. Has all the features you need: pwr/SWR meter, in-built dummy load, all band coverage (including WARC), less than 0.5dB insertion loss.

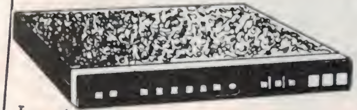
D-2875 **ONLY $149.50**

Base operation?

Just add the FP-707 mains supply & you're away. You get fully regulated 13.5V at 20A. Has plug-in connections so you can't cause problems, plus you get an extra speaker - for greater clarity. D-2895

ONLY $175

Digital VFO



Long'n'slim - intended to sit under the 707. 12 memories, up/down scanning in 10Hz steps & receiver offset tuning. Power by FT-707. D-2896

ONLY $299.50

Mobile bracket

Don't let your valuable 707 jump all around the car. Fit it in this superb mounting bracket for safety & security. Also holds the digital VFO. A must for the serious mobile operator. D-2897

ONLY $36

Economy HF/SSB The FT 101Z

WARC

D-2862

Here is one of the finest transceivers in the 101 family the FT-101Z. This brilliant performer is packed with a host of features, that the more expensive radios lack. So why pay more when you can get features like RF speech processor, variable IF bandwidth, all current HF bands (inc. WARC) 180W input (SSB/CW) & AM/CW/SSB operation & many other features to numerous to mention. So do yourself a favour and check it out NOW at a store near you!

ONLY $795

FT 101ZD

Remember the famous FT-101B? And the 101E? Here is one of the most popular of the 101 series. It has all the features of the famous 101Z but includes digital frequency readout. Stocks are limited so ring the nearest store & check if they have stock left.

D-2859 **ONLY $910.00**

STOCK LIMITED

NEW! FT 101Z FM

Now you can have the features of the renowned FT-101ZD with the benefit of FM. Get crystal clear reception & trouble free interference. It makes a great combination!

$885 D-2872

DC-DC Inverter

Want to go mobile? Add this superb DC/DC inverter to your car battery. (13.5V nominal). Don't tie yourself to your shack - get out to where the DX is great!

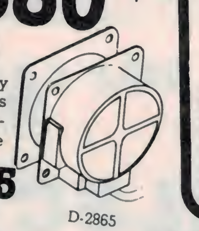
D-2864 **ONLY $77**

FL-2100Z 1.2kW Linear Amp.

If you want a linear amp. built like a 'power house', that gives you a clean, strong signal, try the new WARC FL-2100Z. Australian amateurs can be assured that at our maximum legal limit of 400W PEP the FL-2100Z is just 'coasting' - resulting in years of extra life. It features twin cooling fans for reliable operation & gives plate voltage, VSWR & DC readings from its two large meters. Suits virtually all amateur transceivers on the market

ONLY $580 D-2548

Yaesu Fan

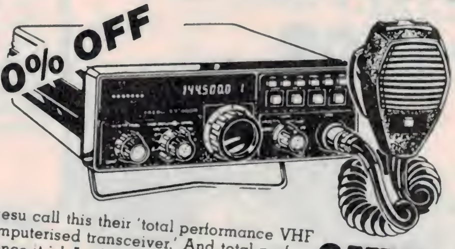


Give your FT-101Z a break by installing a cooling fan. Comes with all the fittings, 110V operated (runs from a tap on the transformer)

ONLY $29.95 D-2865

Yaesu's top 2 metre FT 480R has FM/CW & SSB

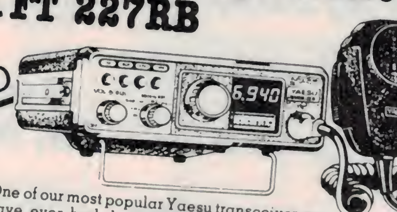
10% OFF



Yaesu call this their 'total performance VHF computerised transceiver.' And total performance it is! As the top-of-the-line Yaesu 2M family you'd expect a lot. You get FM, SSB CW over the full 2M band, with two VFO's, four memory channels, scanning, digital readout, hi/lo power switch & much, much, more. To sum it up in one word, superb!

ONLY $525 D-2887

PLL scanning 2 metre FT 227RB



One of our most popular Yaesu transceiver we have ever had the pleasure to operate the incredible FT-227R. The PLLL scanner will take you anywhere within the 2M band instantly - just press the scan button on the microphone. Has four memory channels, power output of 50W, & the receiver has better than 0.3uV sensitivity (10dB S/N). It operates on 13.5V DC, with protection against reverse polarity & high antenna SWR. For value-for-money, it's hard to go past the FT-227RB.

ONLY $319 D-2891

SPECIAL OFFER

FREE If you purchase a D-4100 base with resonator, we will give a **FREE** 2M stub (D-4102) worth $11.25 at no extra charge.

When you buy the gutter mount base & 2M stub, you're on the air on 2M immediately. As you want the HF bands, simply buy that band resonator/antenna whip & screw it into the 2M stub. You only have to buy the whips for the band you want. Go mobile with Yaesu.

RSE - M - 2 GUTTER MOUNT Cat. D-4100	$24.95	RSL - 7 40M ANTENNA Cat. D-4112	$25.50
RSE - 2A 2M STUB Cat. D-4102	$11.25	RSL - 14 20M ANTENNA Cat. D-4114	$25.50
RSL - 145 6M/2M ANTENNA Cat. D-4104	$27.50	RSL - 21 15M ANTENNA Cat. D-4116	$25.50
RSL - 3.5 80M ANTENNA Cat. D-4110	$25.50	RSL - 28 10M ANTENNA Cat. D-4118	$25.50

DICK SMITH WILL BEAT ANY GENIUNE ADVERTISED PRICE ON YEASU EQUIPMENT.

SAVE $100

D-2868

NOVICE POWER HF/SSB

There aren't many transceivers available in Australia which are particularly suited to novices - but wont disgrace themselves either. The Yaesu FT-7B suits the novice as well as the full call amateur. Gives you all the current HF bands with power output up to 50W. You also have the option of AM, CW or SSB with the choice of VFO or a crystal locked channel. The FT-7B is ready when you are, hook up your power & antenna & away you go!

NOW ONLY $549

November 2 — CB-Day for Britain

The new CB radio facility will start in the UK on November 2 1981. Licences will be available over the counter at post offices for a fee of STG£10 from this date, and one licence will cover the use of up to three transmitter-receiver units using frequency modulation in the 27 MHz or 934 MHz bands.

The licence will cover anyone who lives at the licensee's home, any employees of the licensee and anybody who hires the equipment from the licensee for not more than 28 days. Each additional payment of £10 will cover the use of up to three more units; there is no maximum on the number of units which may be used.

Equipment sold for this new legal service must carry on the front panel a circle containing the legend CB 27/81 or CB 934/81 according to the band for which it is to be used. The existing 27 MHz AM units at present being used illegally will remain illegal unless they are converted to meet the specifications of the new service.

It is expected that initially 27 MHz will be used by the vast majority of CB operators because of equipment availability. It is for speech only and will provide 40 channels between 27.6 and 28 MHz with a transmitter power of 4 W. Maximum range is expected to be some ten to twelve miles, depending on the terrain.

There will be a ban on advertising or soliciting goods or services and on offensive language, but otherwise CB messages will be unrestricted for speech. No music or morse or other non-speech signals will be permitted. Business use will be permitted, so firms may use CB to communicate between offices or between their vans and their offices.

Two performance specifications have been issued by the Home Office for 27 MHz and for 934 MHz equipment respectively and all equipment sold will have to carry a mark on the front panel showing that the equipment conforms to the requirements. In the case of 27 MHz, the antenna will be limited to a straight rod or wire up to 1.5 m long with a base-mounted loading coil to improve its efficiency.

The Home Office stresses that no AM equipment will be legalised in Britain and that there is no European standard at present, although the unification of European standards is regarded as a long-term objective.

The British Home Office makes it clear that CB radio is intended to be a short-range system which is not intended for international communications. People who wish to communicate over long distances by radio should become licensed radio amateurs.

The Home Office has issued a brief voluntary code of practice to help CB users to operate so as to cause as little disturbance to others as possible and to operate safely (such as not transmitting when they are at a petrol filling station and not transmitting when the antenna is within about 10 cm of their face).

Britain has waited a long time for CB radio and many people have suffered interference from the illegal use of AM. Users await the future with keen anticipation.

Brian Dance

New UHF CB portable from Philips

Philips-TMC, who pioneered the introduction of UHF to the Citizen Radio Service with their Australian-designed and manufactured FM320, have now released a portable unit to extend the usefulness of the service.

Called the FM323, it is housed in a lightweight aluminium die-cast case and weighs less than one kilogram when fitted with a rechargeable nickel-cadmium battery pack.

It is not difficult to visualise any number of useful applications on land, at sea or in the air. The unit is expected to prove very popular with a wide range of users: government, business and industry, rural, marine and leisure activities, from controlling road traffic and reporting to security and emergency situations.

Some of the interesting options available with the FM323 are:

- A choice of readily replaceable dry batteries or rechargeable nickel-cadmium cells and a charger unit.
- Soft vinyl pouch or deluxe leather case.
- Tone signalling.

Philips claim the unit has an extremely sensitive receiver and quote a transmitter output of 300 milliwatts. Battery life of approximately 30 hours is expected with a nominal duty cycle of 180 minutes transmit and 180 minutes receiving spread over the battery life.

New Sawtron marine

Imark has released the Sawtron Model 555 27 MHz marine transceiver, which they claim is not a modified CB radio.

The Sawtron 555 has been designed to operate on any dc voltage between 10 and 35 volts, as some vessels employ 12 Vdc systems while others have a 24 or 28 Vdc system.

Corrosion is often a problem in marine environments, so the Sawtron 555 case is made from anti-corrosion light alloy materials and uses stainless steel nuts and screws.

A splash-protected noise-cancelling microphone with a three-metre cord that remains flexible even down to −30°C is provided. Noise suppression circuitry is included to facilitate communications in situations where ignition noise is prevalent. A 'break-in' terminal is also provided to allow use of another transceiver on board at the same time without causing interference to the Sawtron 555.

The transceiver has provision for 12 channels and has the six legal Australian channels fitted. An optional trumpet speaker and marine antenna are also available.

Further information is available from Imark Pty Ltd, 167 Roden St, West Melbourne Vic. (03)329-5433.

Lone radio lady in Antarctic

After eight months in a cardboard hut on a remote plateau in Antarctica, the world's loneliest radio operator, Lady Virginia Fiennes, has talked her way into the history books.

Lady Virginia, wife of British explorer Sir Ranulph Fiennes, has been base station operator in Antarctica for her husband's Transglobe Expedition, currently triumphant after the fastest ever crossing of the frozen continent.

With only an array of expensive high technology radio equipment loaned by the Racal Electronics Group for company, she has spent lonely hours monitoring her husband's progress over the white wasteland with his two fellow explorers, Londoners Charles Burton and Oliver Shepard. Her daily radio schedule included messages of encouragement to the trio as they battled their way 2600 miles over the South Pole to the Scott Antarctic base at McMurdo Sound.

—from Racal 'Grapevine', Spring 1981

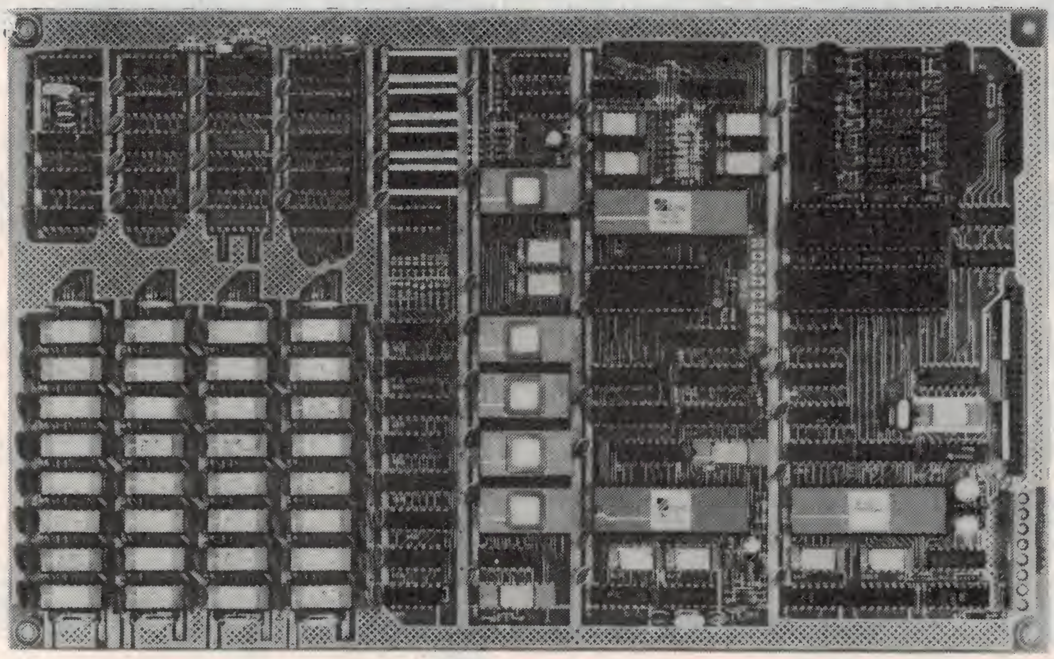
Club Call

The **Brisbane Amateur Radio Club** recently informed us of changes to its address, meeting place and net details. You can now contact the club at P.O. Box 300, Darra Qld. 4076, and meetings are held at the State Emergency Service 'C' Group Headquarters, Cnr. School and Ipswich Rds, Yeronga, Brisbane. Club nets are: Monday 7.30 pm EAT 28450; Monday 8.30 pm EAT 3570; and Wednesday 7.30 pm EAT Channel 51 — 146.660 MHz.

The **South Coast Amateur Radio Club** (callsign VK5ARC) meets on Thursday evenings at the Clubrooms, 12 Baden Tce, O'Sullivan Beach S.A. You can contact the club at P.O. Box 333, Morphett Vale S.A. 5162. Club net is each Tuesday evening at 8 pm on 3.595 MHz ±QRM. Visitors to the club and net are welcome.

SINGLE BOARD COMPUTER KIT
NOW ONLY $649 (Tax Exempt)

Also available, Blank PCB's with Roms **4295** + Tax.



THE FERGUSON PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M*. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, and an enclosure; and you have a total Business System for about 1/3 the cost you might expect to pay.

SIZE: 8½ x 13¾ IN.
SAME AS AN 8 IN. DRIVE.
REQUIRES: ·5V @ 3 AMPS
· - 12V @ .5 AMPS.

FEATURES: (Remember, all this on one board!)

64K RAM

Uses Industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERUPTS. Fully buffered and runs 8080 software

SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: **$95**

BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true.

FLOPPY DISC CONTROLLER

Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M* 2.2.

FOUR PORT PARALLEL I/O (OPTIONAL)

Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O: **$45**

REAL TIME CLOCK (OPTIONAL)

Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: **$25**

PFM 3.0 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.0 on board monitor. PFM commands include: Dump Memory, Boot CP/M*, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided. It does not occupy any of the 64K of system RAM!

CP/M* 2.2 FOR BIG BOARD

The popular CP/M* D.O.S. modified by MICRONIX SYSTEMS to run on Big Board is available for $150.00.

TERMS CASH CHEQUE OR BANKCARD (MIN $100 DEP)

ALL PRICES PLUS TAX IF APP

REGISTERED PACK & POST $5.00

RITRONICS WHOLESALE

425 High Street, Northcote, VIC.
Phone (03) 481-1923, 489-7099.
PO Box 235. Telex AA 38897.

Copy of manual and assembly instructions $15. Refundable on purchase of board. Photocopy exchanged for original. Delivery ex stock.

ETI

Bankcard Mail Orders Welcome

Please debit my Bankcard

Bankcard No ....

Expiry Date ....

Name ....

Signature ....

Babani Books

1ST BOOK OF TRANSISTOR EQUIVALENTS & SUBSTITUTES
Complete transistor equivalents. Plus 25 000 transistors with alternatives and equivalents. Covers devices from UK, USA, Germany, France, Europe, Hong Kong etc. See also 211 and BP14.
BP1 **$2.25**

HANDBOOK OF RADIO, TV, INDUSTRIAL & TRANSMITTING TUBE & VALVE EQUIVALENTS
Equivalents book for amateurs and serviceman. More than 18 000 old and new valves from UK, USA, Europe, Japan et al. CV (military) listings with commercial equivalents included.
BP2 **$2.25**

COLOUR CODE & DATA CHART
A very useful wall chart containing resistor and capacitor colour codes and how to read them, audio connector colour codes, transformer wires colour codes, battery cord colour codes, PLUS — charts and formulae for resistors, capacitors and inductors in parallel and series; resistor power ratings chart, 50/75 ohm attenuator tables and more ...
BP7 **$1.50**

2ND BOOK OF TRANSISTOR EQUIVALENTS & SUBSTITUTES
Data on devices not included in BP1. This book supplements BP1, i.e. no data is duplicated.
BP14 **$4.05**

FIRST BOOK OF PRACTICAL ELECTRONIC PROJECTS
Full constructional data, circuits, components lists for many practical projects including audio distortion meter, super FET receiver, guitar amp, metronome, etc. etc.
BP23 **$2.75**

52 PROJECTS USING IC 741
A must for those interested in any way in this inexpensive and versatile IC. European best seller!
BP24 **$3.50**

GIANT CHART — RADIO, ELECTRONICS, SEMI-CONDUCTOR & LOGIC SYMBOLS
Identify those symbols at a glance. A must for beginners and advanced enthusiasts alike. Professionals can always hide it in their desks! A steal at only . . .
BP27 **$2.20**

ELECTRONIC CALCULATOR USERS' HANDBOOK
Invaluable for all calculator users. Presents formulae, data, methods of calculation, conversion factors etc, often with examples. Includes way to use simple calculator for trig functions (sin, cos, tan); hyperbolic functions (sinh, cosh, tanh); logs; square roots, and powers.
BP33 **$4.60**

50 CIRCUITS USING GERMANIUM, SILICON & ZENER DIODES
Contains 50 interesting and useful circuits and applications in many different branches of electronics.
BP36 **$2.75**

50 PROJECTS USING RELAYS, SCRs & TRIACS
Relays, SCRs and Triacs are used in motor speed control, dimming, heating, timers, light sensitive devices, warning circuits, light modulators, priority indicators, circuit breakers etc. Book gives tried and proven circuits allowing easy modification to suit special needs.
BP37 **$4.60**

FUN AND GAMES WITH YOUR CALCULATOR
Amazing collection of 101 jokes and riddles, several quite mind-boggling games for two or more players and a dictionary of numbers which are words if the calc. is read upside down.
BP38 **$2.75**

DIGITAL ICs & PIN CONNECTIONS
Equivalents and pin connections of popular user-orientated digital ICs. Details of packaging, families, functions, manufacturer, and countries of origin. Includes Fairchild, Ferranti, Harris, ITT, Motorola, National, Philips, RCA, Signetics, Sescocem, SGS-Ates, Siemens, SSSI, Stewart Warner, AEG-Telefunken, Texas, Teledyne. Companion volume to BP41.
BP40 **$9.00**

LINEAR IC EQUIVALENTS & PIN CONNECTIONS
Similar to BP40 but deals with linear ICs.
BP41 **$10.00**

HOW TO MAKE WALKIE-TALKIES
Practical circuitry and construction of transmitters, receivers and antennas. A book of great interest to the licenced operator especially. This book was written with the UK licencing regulations in mind. Some parts may not accord with local regulations.
BP43 **$5.50**

IC555 PROJECTS
One wonders how life went on before the 555! Included are basic and general circuits, motor car and model railway circuits, alarms and noise makers plus section on subsequent 556, 558 and 559s.
BP44 **$6.45**

PROJECTS IN OPTO-ELECTRONICS
Included are simple circuits using LEDs as well as sophisticated designs such as infra-red transmitters & receivers, modulated light transmission and photo projects.
BP45 **$4.95**

LM 3900 IC PROJECTS
Unlike conventional op-amps, the LM 3900 can be used for all the usual applications as well as many new ones. It's one of the most versatile, freely obtainable and inexpensive devices around. This book provides the groundwork for simple and advanced uses — it's much more than a collection of projects. Very thoroughly recommended.
BP50 **$4.95**

ELECTRONIC MUSIC & TAPE RECORDING
Shows how electronic music can be made at home with simple and inexpensive equipment. Describes how sounds are created and recorded to build up final compositions. Includes how to build a small studio including mixer and effects units
BP51 **$4.60**

LONG DISTANCE TV RECEPTION (TV-DX).
Written by UK authority, the book includes many units and devices made by active enthusiasts. A practical and authoritative intro to this unusual aspect of electronics.
BP52 **$4.60**

PRACTICAL ELECTRONIC CALCULATIONS & FORMULAE
For the practical person's workbench. Bridges gap between technical theory and cut-and-dried methods which work but leave the experimenter unfulfilled. There's a strong practical bias. Tedious and higher maths avoided where possible. Many tables included. This one's a beauty!
BP53 **$8.25**

RADIO STATIONS GUIDE
Eight sections covering: European LW/AM; European, Near East and N. African MW/AM; World-wide SW/AM; European FM/VHF; Broadcast band USA; Broadcast band Canada; Local UK; Wavelength/frequency conversion. Book shows station site, country, frequency, wavelength, effective radiated power and, in some cases, call sign.
BP55 **$6.45**

ELECTRONIC SECURITY DEVICES
Simple and also sophisticated alarms using light, infra-red and sonics; also gas and smoke detectors, flood alarms, doorphone and baby alarms etc.
BP56 **$5.35**

HOW TO BUILD YOUR OWN SOLID-STATE OSCILLOSCOPE
Project divided into sections for builder individually to construct and test — then assemble into complete instrument. Includes short section on 'scope usage.
BP57 **$5.50**

50 CIRCUITS USING 7400 SERIES ICs
7400 ICs are freely obtainable, inexpensive and very versatile. Here's 50 interesting and useful circuits using this IC.
BP58 **$4.95**

Babani Books

PRACTICAL CONSTRUCTION OF PRE-AMPS, TONE CONTROLS, FILTERS, & ATTENUATORS
How to construct a variety of magnetic tape recording, microphone, and disc pre-amps; plus tone controls, rumble & scratch filters, attenuators and pads etc etc.
BP60 **$5.30**

BEGINNER'S GUIDE TO DIGITAL ELECTRONICS
Covers all essential areas including number systems, codes, constructional and sequential logic, analog/digital/analog conversion.
BP61 **$3.50**

ELEMENTS OF ELECTRONICS
This series provides an inexpensive intro to modern electronics. Although written for readers with no more than basic arithmetic skills, maths is not avoided — all the maths is taught as the reader progresses.
The course concentrates on the understanding of concepts central to electronics, rather than continually digressing over the whole field. Once the fundamentals are learned the workings of most other things are soon revealed. The author anticipates where difficulties lie and guides the reader through them.

BOOK 1 (BP62): All fundamental theory necessary to full understanding of simple electronic circuits and components.

BOOK 2 (BP63): Alternating current theory.

BOOK 3 (BP64): Semiconductor technology leading to transistors and ICs.

BOOK 4 (BP77): Microprocessing systems and circuits.

This series constitutes a complete inexpensive electronics course of inestimable value in hobby or career.

Books 1/2/3 **$8.25 (each)**
Book 4 **$10.80**

BEGINNERS' GUIDE TO MICROPROCESSORS & COMPUTING
Introduction to basic theory and concepts of binary arithmetic, microprocessor operation and machine language programming. Only prior knowledge assumed is very basic arithmetic and an understanding of indices.
BP66 **$6.40**

COUNTER DRIVER AND NUMERAL DISPLAY PROJECTS
Well-known author F.G. Rayer features applications and projects using various types of numerical displays, popular counter and driver ICs, etc.
BP67 **$6.10**

ELECTRONIC GAMES
How to build many interesting electronic games using modern ICs. Covers both simple and complex circuits for beginner and advanced builder alike. Good one!
BP69 **$6.40**

TRANSISTOR RADIO FAULT-FINDING CHART
How to trace most common faults quickly. Top of chart indicates faults — users then follow arrows indicating checks in correct sequence until fault is cleared. Clever one!
BP70 **$1.85**

A MICROPROCESSOR PRIMER
This small book takes the mystery out of microprocessors. It starts with a design for a simple computer described in language easy to learn and follow. The shortcomings of this basic machine are then discussed and the reader is shown how these are overcome by changes to the instruction set. Relative addressing, index registers follow as logical progressions.
An interesting and unusual approach.
BP72 **$6.40**

REMOTE CONTROL PROJECTS
Covers radio, infra-red, visible light, ultrasonic controls. Full explanations are provided so that the reader can adapt the projects for domestic and industrial as well as model use.
BP73 **$7.15**

ELECTRONIC TEST EQUIPMENT CONSTRUCTION
Describes construction of wide range of test gear including FET amplified voltmeter, resistance bridge, field strength indicator, heterodyne frequency meter etc.
BP75 **$6.40**

POWER SUPPLY PROJECTS
Designs for many power supplies including simple unstabilised, fixed and variable voltage regulators — particularly for electronics workshops. Also included are cassette power supply, Ni-Cad charger, voltage step-up circuit, and simple inverter, plus info on designing your own supply. All designs are low voltage types for semiconductor circuits.
BP76 **$6.40**

PRACTICAL COMPUTER EXPERIMENTS
How to build typical computer circuits using discrete logic. This book is a useful intro to devices such as adders and storers as well as a general source book of logic circuits.
BP78 **$6.50**

RADIO CONTROL FOR BEGINNERS
How complete systems work with constructional details of solid state transmitters and receivers. Also included — antennas, field strength meter, crystal controlled superhet, electro-mechanical controls. Ideal for beginners. Section dealing with licencing etc not applicable to Australia.
BP79 **$6.40**

POPULAR ELECTRONIC CIRCUITS — BOOK I.
Yet more circuits from Mr. Penfold! Includes audio, radio, test gear, music projects, household projects and many more. An extremely useful book for all hobbyists offering remarkable value for the designs it contains.
BP80 **$7.15**

ELECTRONIC SYNTHESISER PROJECTS
For the electronic music enthusiast, an invaluable reference. This book is full of circuits and information on how to build analogue delay lines, sequencers, VCOs, envelope shapers, etc, etc. The author takes a clear and logical approach to the subject that should enable the average enthusiast to understand and build up what appears to be a quite complex instrument.
BP81 **$6.45**

VMOS PROJECTS
A book to suit the dyed-in-the-wool experimenter. Though primarily concerned with VMOS power FETs and their applications, power MOSFETs are dealt with too in a chapter on audio circuits. A number of varied and interesting projects is covered under the headings: Audio Circuits; Sound Generator Circuits; DC Control Circuits and Signal Control Circuits. Learn while you build.
BP83 **$7.20**

DIGITAL IC PROJECTS
Companion to No. 225 Practical Introduction to Digital ICs and BP61 Beginners' Guide to Digital Electronics. The projects included in this book range from simple to more advanced projects — some board layouts and wiring diagrams are included. The more ambitious projects have been designed to be built and tested section by section to help the constructor avoid or correct any faults that may occur.
BP84 **$7.20**

INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE
Companion to BP1 and BP14 equivalents books, but contains a huge amount of information on modern transistors produced by over 100 manufacturers. Wherever possible, equivalents are subdivided into European, American and Japanese types. Also shown are the material type, polarity, manufacturer and indication of use or application.
BP85 **$10.85**

HI-FI LOUDSPEAKER ENCLOSURES
Data for building corner reflex, bass reflex, exponential horn, folded horn, tuned port, Klipschorn labyrinth, tuned column, loaded port and multi speaker panoramics. Clear dimensioned diagrams included.
205 **$3.50**

Babani Books

PRACTICAL ELECTRONIC SCIENCE PROJECTS
Unusual projects including laser, electronic gas detector, ultra high voltage generator, digital clock, reaction timer, geiger monitor, ultrasonic receiver and transmitter, electroscope etc.
207 **$2.75**

DIODE CHARACTERISTICS, EQUIVALENTS & SUBSTITUTES
Includes signal, zener, rectifier diodes etc. Full interchangeability data and characteristics of thousands of diodes of all types with every possible alternative. Includes UK, USA, European, Russian, and Far Eastern devices.
211 **$4.60**

ELECTRONIC CIRCUITS FOR MODEL RAILWAYS
Constructional details of a simple model train controller; a controller with simulated inertia, a high-power controller, an electronic steam whistle and a 'chuff generator'. Signal systems and train lighting and RF suppression also covered.
213 **$3.65**

BUILD YOUR OWN ELECTRONIC EXPERIMENTER'S LAB USING ICs.
Includes many circuits and designs for constructing test and measuring instruments mostly using modern ICs. Includes AF osc, TTL pulse detector, hi-impedance Vm, square-wave osc/pulse gen, logic probe, lo-range ohmmeter, bridge, signal tracer etc.
218 **$3.10**

BUILD YOUR OWN HI-FI & AUDIO ACCESSORIES
Essential for keen hi-fi & audio enthusiasts. Projects include stereo decoder, three channel mixer, FET pre-amp for ceramic p.u.s, mic pre-amp with adj. bass, stereo dynamic noise limiter, loudspeaker protector, voice operated relay etc.
220 **$3.10**

28 TESTED TRANSISTOR PROJECTS
Some circuits are new, others are familiar designs. Projects can be split and/or combined for specialised needs.
221 **$4.60**

SOLID STATE SHORT WAVE RECEIVERS FOR BEGINNERS
Design and construction of several solid-state short-wave receivers giving high level of performance yet utilising relatively few inexpensive components. See also 226.
222 **$4.60**

50 PROJECTS USING CA 3130 ICs.
The CA 3130 is an advanced operational amplifier capable of higher performance than many others: circuits often need fewer ancillary components. Interesting and useful projects in five groups. Audio projects. RF projects. Test equipment. Household projects. Misc. projects
223 **$4.60**

50 CMOS IC PROJECTS
Many interesting and useful projects — multivibrators; amplifiers and oscillators; trigger devices; special devices.
224 **$4.60**

PRACTICAL INTRO TO DIGITAL ICs
Introduction to digital ICs (mainly TTL 7400). Besides simple projects, includes logic test set to identify and test digital ICs. Also includes digital counter-timer.
225 **$4.60**

HOW TO BUILD ADVANCED SHORTWAVE RECEIVERS
Full practical constructional details of receivers with performance equal to commercial units. Also 'add-on' circuits of Q meter, S meter, noise limiter etc.
226 **$4.60**

BEGINNERS GUIDE TO BUILDING ELECTRONIC PROJECTS
Enables total beginners to tackle electronic projects. Includes component identification, tools, soldering, building methods, cases, legends etc etc. Practical basic projects are included.
227 **$4.60**

ESSENTIAL THEORY FOR THE ELECTRONICS HOBBYIST
This book supplies hobbyists with background knowledge, tailored for his or her specific requirements and presented in a readable manner with minimum maths. Purpose-designed examples illustrate applications.
228 **$4.60**

ORDER FORM

ALL TITLES SUBJECT TO AVAILABILITY

Please forward

Book	Qty						
		BP1	......	BP45	......	BP67	......
205	......	BP2	......	BP50	......	BP69	......
207	......	BP7	......	BP51	......	BP70	......
211	......	BP14	......	BP52	......	BP72	......
213	......	BP23	......	BP53	......	BP73	......
218	......	BP24	......	BP55	......	BP75	......
220	......	BP27	......	BP56	......	BP76	......
221	......	BP33	......	BP57	......	BP77	......
222	......	BP36	......	BP58	......	BP78	......
223	......	BP37	......	BP60	......	BP79	......
224	......	BP38	......	BP61	......	BP80	......
225	......	BP40	......	BP62	......	BP81	......
226	......	BP41	......	BP63	......	BP83	......
227	......	BP43	......	BP64	......	BP84	......
228	......	BP44	......	BP66	......	BP85	......

Trade enquiries welcomed

Send to: ETI 'Book Sales', 4th Floor,
15 Boundary St, Rushcutters Bay NSW 2011.
Please allow 4 - 5 weeks for delivery.

Post & handling:

1 - 4 books:	$1.35	11 - 20 books:	$3.50
5 - 10 books:	$2.70	over 20 books:	$5.00

I enclose $ .... **(inc. p & h.)**

Name ....

Address ....

....

.... **postcode** ....

'Shop by computer' with Dick Smith

While everyone else in the world is talking about it — Dick Smith has done it!

He has introduced Australia's first "Shop by Computer" System — a system where you use your personal computer through your telephone to shop from your home or business, anywhere in the world, directly onto the Dick Smith Computer.

Dick Smith is so excited about this new system that he foresees the day when most of his 45 000 mail order customers will use this system. With $4 million turnover from these customers, Dick wants to make it as easy as possible for them.

Until now, ordering electronic equipment by mail order has cost the consumer a lot of time and money. The order, by mail, can take up to five days (at best!) to reach its destination. By using the 'Shop by Computer' System, the customers can place an order through their own personal computer, and at the touch of a key the order is received at Dick Smith Electronics in less than a minute.

The Dick Smith Ordering System is said to be simple to use and anyone with the right equipment can take advantage of it. All you need is a Dick Smith System 80 or a Tandy TRS-80 computer, an expansion unit with an RS-232C port, a 5¼" disk drive and an acoustic coupling modem. As an introductory offer Dick Smith is making the simple program available at cost price (about $5). Over Australia there are 12 000 owners of Dick Smith and Tandy computers, and all of these can use this system.

Once you type your order into your computer, you phone Dick Smith's number and your order is transferred directly to the Dick Smith Computer. The computer acknowledges receipt of the order and also lets you know the latest specials that Dick Smith Electronics has to offer. Your order is also given preferential despatch treatment and would normally be on its way within four hours of its being received. It is also automatically billed via a nominated credit card account.

Dick Smith says, "I predict now that we have the System that thousands of our customers will buy using it."

Fountain of knowledge

The Source is with us! That famous Californian data bank, 'The Source', now has a counterpart right here. Called the Australian Source, it is a division of Tergo Quen Pty Ltd, headed up by well-known computer industry identity, Gary Alpert.

"The launching of the Australian Source microcomputer network in Australia is probably the most singularly important event yet to take place in the microcomputer industry in this country," he said when announcing the launch.

"For the first time, the world of huge data banks and massive computer power previously only available to large corporations and government departments can now be put into any office or any home for less than the cost of a few packets of cigarettes a day.

"Thus this is really the beginning of the era of the home computer, as now virtually any small businessman or any student can have on his desk for an extremely small cost a system that has the level of storage power and access to data banks that only a few years ago government departments and large private users were paying millions of dollars for."

The Australian Source is a computer information utility which can be accessed through any number of 'approved' personal microcomputers. Through this system, microcomputer owners will be able to:

- have access to a number of information sources, which will include the news, financial reports and sports;
- communicate nationwide with other Australian Source users — virtually an electronic mail system;
- have access to a myriad of computer programs that include entertainment, educational aids, programming and diagnostic tools and financial applications;
- have the capability to make use of the mainframe's huge storage capacity, to use its large programs or store your own programs in the system;
- take advantage of the 'shopping by computer' system to get the best price of many popular consumer items.

To join the Australian Source you need to have an 'approved' microcomputer system. At present the following systems may be used: Apple, Atari, Casio, Commodore, System 80, TRS-80 and numerous S100 systems (you need a disk-based system with CP/M). Mr Alpert expects the range of suitable systems to be expanded rapidly.

There is a one-time joining fee and a small hourly charge for usage. The joining fee is $100, but 'charter' members joining now get a discount and the fee is only about $60, according to Gary Alpert. The hourly rate works out at about $10 per day for use during business hours, dropping to around $4 per day where usage is mainly during the evenings.

Initially, for users outside Melbourne, where the central computer is located, users will have to make an STD phone call to access the Australian Source, but by February or March next year Gary Alpert expects that users in the capital city metropolitan areas will only have to make a local call.

For more information, contact the Australian Source, 364 Latrobe St, Melbourne Vic 3000. (03) 329-7998.

APPLIED TECHNOLOGY –

The Starter Pack

Do you want to build a computer which won't end up limiting your needs and interest? Are you tired of 'packaged' systems which are never exactly what you want? Do you want to get into computing for as little as $349 and have a machine which can run some of the most powerful software available? Do you want a full S100 expandable machine? Then you need to know about Applied Technology's Z80/S100 computer cards and systems.

As Australia's largest manufacturer and designer of Z80/S100 cards we have the know-how to offer a range of systems tailored to suit you. You can start with low cost kits and modules (all backed with the finest technical support), and build up to a full disk based system running CP/M and the world's finest software.

With two extremely powerful S100 cards, mother board and sockets, you get into computers without compromise and you're already on the S100 bus.

The pack includes:

The ultra-powerful DGZ0 S100 CPU board (kit form). This board offers features such as built in printer interfaces, an extremely powerful monitor in ROM, an 8-bit input port, two programmable I/O ports, a real time clock (yes you can have the computer perform time related tasks, as many of our industrial customers are doing now).

The MW640 VDU Board. This is a professional VDU board offering upper and lower case (and a screen that doesn't flicker every time you key something in). It produces 16 lines of 64 characters. Chunky graphics are also available.

We can't do justice here to the power and flexibility of these cards. We believe they will give you the finest takeoff point available in personal computing today. Learning to operate them, with AT's technical and software backup will give you more computer understanding than on any other Micro.

You also get a 4-slot Motherboard and S100 sockets. All you need to get the system up and running is a simple 7V/2A power supply and an ASCII encoded keyboard.

Save $94.00 on normal price of components. **$349**

ADVANCED 16K/BASIC SYSTEM

Once you have mastered your base system, the addition of our BASIC in ROM + 16K RAM package will allow you to run longer programs and learn to program in the fantastically powerful 12K MICROWORLD BASIC. This BASIC is a truly interactive language which actually gives you feedback as you program – your skill and familiarity will increase very quickly.

The package includes the MW2516 ROM card with BASIC in ROM and the AT16K RAM card with proven static memory. Being on the S100 system, you just plug these straight in to your motherboard. With these two packages you have a machine which outclasses TRS-80, SYSTEM 80 and SORCERER in terms of instructional power, expandability and cost of expansion.

16K RAM + 12K BASIC ROM. Save $80 on normal price of boards **$279**

KEYBOARDS FOR STARTER PACK

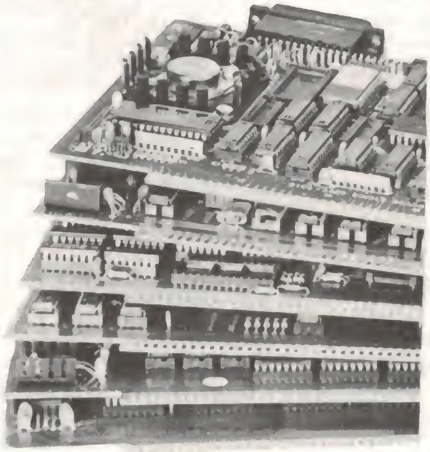
RCA Touch keyboard (complete with its own case). ***$89.50***

OR

Clare Model 70 Microprocessor controlled keyboard (serial and parallel outputs) ***$169.00***

Case to suit Clare ***$27.50***

S100 BOARDS



2650 SBC *Complete CPU based on the 2650 microprocessor. Includes 4K static RAM, 3 parallel ports.*
Complete kit ***$209.00***

SCVT *Serial Video Terminal uses Thomson CSF dedicated VDU controller.*
Complete kit ***$189.50***

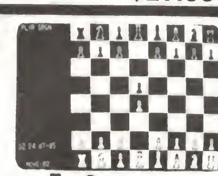
DGZ80 CPU *Complete CPU with Z80 CPU, CTC and PIO.*
Complete kit ***$199.00***
Assembled & tested ***$239.00***

AT16K RAM *16K of reliable static RAM.*
Assembled & tested 450nS ***$199.00***

TCT Block Lockable RAM *16K of RAM arranged in 4 independent 4K blocks.*
Assembled & tested 450nS ***$249.00***

MW640 VDU *Memory mapped, 64x16 lines, upper/lower case, chunky graphics.*
Assembled & tested ***$169.50***

SOFTWARE NEW RELEASES



$5.50 each!

DGOS format on cassette tape.
Cassette with documentation.

WUMPUS. The popular cave hunting game.
LIFE. Fascinating use of graphics on the VDU
CALENDAR-MAKER. Prints calendars for any year you want.
MAZE-MAKER. Prints mazes to any specified width and length.
BANNER-PRINT. Prints your name in big characters.
BIG VDU. Converts the MW640 to produce large characters on the screen.
BIORHYTHM. Impress your friends and print out their points at a party game.
TYPE DRILL. Teach yourself to touch type.
ELIZA. The first artificial intelligence program.
HEXAPAWN. A chess type game, but the computer learns from its mistakes.
MICROWORLD LEVEL II BASIC. 12K of powerful program on cassette. **$19.75**
Or in ROMs **$75.00**
PILOT. The simplest to learn language. Ideal for education & string oriented applications. **$14.75**

PERIPHERALS

PRINTERS

Itoh 8500 Graphics/Dot matrix. 100 characters per second (44 lines per minute full 80 character print). True descenders and logic seeking circuitry.
Parallel interface **$895.00**

TEC TE1500 Daisy wheel. 400mm wide, standard Diablo print wheel.
RS232 interface **$1,895.00**
Centronics interface **$1,865.00**

MICROPOLIS DISK DRIVES

5¼" – S100 compatible –315K per drive
1043 MOD II: single drive including controller board, power supply, 24K BASIC, MDOS & MICROWORLD RES. **$995.00**
1023 MOD II add on drive **$665.00**
1053 MOD II Dual drive. Other features as per 1043 Plus CP/M 2.2 **$1,675.00**

DIGITALKER

The MICROWORLD DIGITALKER is based on a speech processing unit and encoded ROMs from National Semiconductor. Although an S100 device, the Digitalker is port oriented and can be readily adapted to interface with virtually any microprocessor such as INSTRUCTOR 80, TRS-80, SORCERER or SYSTEM 80.

Comes complete with technical applications notes. It has 143 addressable expressions, giving it a huge vocabulary. **$149**

WOULD YOU LIKE TO KNOW MORE?

Then send for our catalogue of computer products. It gives full technical details and introduces you to our wide range of S100 products, software & peripherals. Find out about our Newsletter – keeps you informed about new products & developments in the MicroWorld range.

YOUR COMPUTER SUPERMARKET

FREE PRICE LIST AVAILABLE

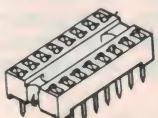
Because we are a major Australian manufacturer of S100 computer products, we buy huge quantities of digital and computer related ICs and hardware. You benefit from our technical knowledge and buying power. You can now buy the same components that we use in our own manufacturing (so they have to be good) at prices which make most 'computer suppliers' look very expensive. The items on this page show only a few of our lines, which now total over 5,000!! We have compiled a price list. Send or phone for it today!

IC SOCKETS

New Super Low Prices!

All our S100 boards use sockets, so we buy in huge volume –50,000 at a time, and for reliability we only buy the best – TI and Scanbe. Try and buy quality sockets at these prices!

8 pin DIL	20¢ each
14 pin DIL	24¢ ea
16 pin DIL	28¢ ea
18 pin DIL	35¢ ea
20 pin DIL	40¢ ea
24 pin DIL	45¢ ea
28 pin DIL	50¢ ea
40 pin DIL	75¢ ea



Wirewrap

14 pin DIL	80¢ ea
16 pin DIL	85¢ ea
18 pin DIL	95¢ ea

For further range, phone or write for our catalogue.

S100 Socket

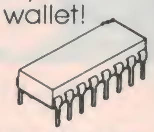
$7.95 each or a set of 5 for only $35.00 – Save $4.75!

All these prices are current until 31st December
We buy at OEM prices and you reap the benefit!

LS for Less

These ones won't drain your power supply or your wallet!

74LS00	**20¢**
74LS367	**80¢**
74LS157	**60¢**
74LS241	**$1.20**
4001	**20¢ (don't pay 48¢)**



LEDs

Rectangular

Red	**15¢**
Green	**20¢**
Yellow	**20¢**

Computer Grade Cassettes

Australian manufactured to our specifications.

C10	$1.00
C20	$1.20
C30	$1.30
C45	$1.60
C60	$1.75

25 Way RS232 Type 'D' connectors

Assemble your own RS232 interface using these top quality standard 25 way connectors.

DB-25-P 25 way plug	$5.75
DB-25-S 25 way socket	$8.75
DB-25-H hood for plug/socket	$2.75

THE Z80 FAMILY

Unbelievable discount prices

Z80A CPU	**$7.95**
Z80 PIO	**$6.95**
Z80 CTC	**$6.95**

Don't pay $15.95 for a Z80 CPU. Buy from the computer specialists and save.

MEMORY

2516 EPROM	**$5.95**
2114/4 RAM	**$2.75**
	8 for $20.00!
82S/123 32x8 PROM	**$3.95**
NEW 6116 CMOS RAM	**$19.75**

Send for our data applications package on these fantastic 6116 RAMs. Only $2.50. It will show you how to build your own non-volatile memory – yes battery backup is possible with these incredible new chips. Another AT first!

UARTS

1854AE CMOS UART	**$7.95**
5330 MOS UART	**$6.95**

Voltage regulators

TO220 Fixed voltage regulators

Positive	Negative
7805	7905
7806	7912
7808	7915
7812	7918
7815	7924
7818	All $1.50 each
7824	
All $1.10 each	

LM317T Variable	$1.95
LM309K 5V/1A TO3	$1.95
LM323 5V/3A TO3	$8.95

Zener Diodes

All standard values from 3.3V to 30V/1W rating
Only 20¢ each - Don't pay 29¢ each

BUY DIRECT & SAVE

How can we offer professional S100 systems and high quality components at such low prices and still stay in business? We can do this because we sell direct, we don't have dozens of expensive outlets and we sell a large percentage of our goods through our fast and efficient Mail Order Department. This allows us to keep our costs down and operate on much lower profit margins. This, plus strong buying power for our manufacturing operation means you benefit.

Blue Ribbon Mail Order Service

Join our 10,000 active mail order customers. Including some very big names – Racal, BHP, Mt. Isa Mines, ICL, even IBM!!! Our fast mail order division is ready to despatch orders received by mail. The standard charge is $2.00 per order to cover package and postage. Mail orders to

PO Box 355, Hornsby 2077

Interstate? Need goods urgently?

You need our $7.00 Overnight Freightbag. Phone in today (with your Bankcard this is especially easy) and we'll get the goods away tonight.

Order direct - it's quicker than driving

Sick of driving across town, wasting time and petrol? Do you own a Bankcard? Then use our super fast phone order/Bankcard service.
Phone (02) 487 2711, give your Bankcard number, expiry date, name and address with your order, confirm cost and availability and the goods are on their way. Yes, shopping with us is just that quick and easy.

APPLIED TECHNOLOGY

Showroom/Office at 1A Pattison Ave. Waitara
Hours: 9-5 Monday to Saturday.
Phone: (02) 487 2711 Telex: APPTEC AA72767

Glover & Assoc. AT/5

Printout

Painless computerisation — how it's done

When the management services officers of Western Australia's Department of Education decided to investigate word processing and its implementation in their department, they certainly did their homework well.

They looked at the short term word processing needs of the Department — to cope only with such things as the preparation of its budget — but, with a staff of 160 typists, finally decided on a more integrated approach.

By various surveys, interviews and workload assessments in seven separate geographical and functional areas, they assessed whether word processing was economical, viable and suitable for the Department's needs, both short and long term. Having established that word processing could be installed successfully, they put the system required out to tender, specifying shared logic, storage amounts, etc, and the ability to expand later.

One of the first problems encountered by the officers was understanding the jargon spoken by the computer personnel of the companies which responded to the tender. As one of them put it, "We needed to learn their language so we could fully understand what they were offering. We couldn't afford to be left out in the cold because of our own lack of knowledge."

The management services officers looked at various installations in different applications around Australia, paying particular attention to installations which did not work well in order to learn from other people's mistakes rather than their own! They finally settled on three Wordplex/2 and one Wordplex/4 word processors and four screens from Sigma Data, the assurances given by the company regarding support facilities being one of the deciding factors. Sigma Data place a great deal of emphasis on support, employing a large number of engineers and MSRs to look after customers' needs.

The management services officers did not forget the last vital link — the operators of the carefully selected equipment. "One thing we have learnt is that it is far more efficient and productive to use the equipment to its fullest capacity. Therefore, to encourage a positive attitude to word processing by all our typists, we felt education was vital. As a result, we organised a series of talks at each location, an audio-visual display, seminars for authors and other aids as an introduction to the whole concept."

With all the effort and dedication that has gone into installing a computer system, the WA Department of Education deserves to have one of the most efficient computer installations in the country!

Sigma Data Corporation may be contacted at its Head Office, 157 Walker St, North Sydney NSW 2060. (02)922-3100.

Sorcerer notes

A.P.F. Fry, who writes our Sorcerer Apprentice column every month, dropped us a line recently to tell us of a modification to a program he previously sent us.

While experimenting with the routine published in the February '81 issue to test whether or not your printer is connected, he found that if the program containing this routine, or a previously run program, has used the keyboard scanning routine published in ETI December 1980, the program will drop back to the monitor and print:

ERROR — INVALID COMMAND

This can be corrected with the following routine:

```
10 POKE 318,219:POKE 320,201
20 PR=INP(255)
30 IFPR=255THENPRINT"THERE
IS NO PRINTER CONNECTED"
:END
40 PRINT"THERE IS A PRINTER
CONNECTED"
```

Line 10 restores locations 318 and 320 to their initial power-on condition and ensures the routine works successfully.

Thanks for the information!

New models from Casio

Casio's new pocket computer, the FX-702p, has a host of features too numerous to print here, plus a large program library of 73 programs covering mathematics, electrical engineering, mechanics, physics, chemistry, statistics, medicine, banking, navigation and games.

The FX-702p stores up to ten programs, has 55 keyboard functions, and is said to have a processing speed more than ten times as fast as other pocket computers — plus lots more! Programs and data may be recorded on an ordinary cassette by means of the FA2 adaptor, and the FP10 printer will also be available to interface with the pocket computer in the near future.

The FX-702p is priced at $233.70 ($259.95 including sales tax).

The new Casio FX-602p programmable pocket calculator has a dot matrix liquid crystal display which allows for upper and lower case characters, numbers and

symbols — 86 different characters in all. It is claimed to be extremely powerful, and has 50 mathematical and scientific functions on the keyboard. It can store up to ten programs on its continuous memory, and also interfaces with the FA2 and FP10.

The FX-602p is priced at $172.95 ($189.95 including sales tax), and both it and the FX-702p are available from Calculator & Computer Distributors, 3 Rowley St, Seven Hills NSW 2147. (02)624-8400.

New products at Electronic Concepts

Electronic Concepts Pty Ltd now have available various new products in their distribution range.

Micro Focus, the marketers of CIS COBOL and FORMS-2 (two professional software products) have released these products packaged especially for Apple II. The package consists of easy-to-use language extensions for CRT screen handling and a comprehensive interactive debug package. It is necessary to have the Z80-based Softcard (by Microsoft) installed.

Coinciding with the release of these products is the news that Telecom approval has been obtained for the connection of Apple II computers via their RS232C interface to any approved modem or modem/multiplexer. According to Electronic Concepts, the combination of an industry-standard COBOL and a communication facility is the last hurdle for Apple II to obtain acceptance in the COBOL-dominated world of EDP users.

Electronic Concepts also have available the Seikosha GP80, a small but heavy duty dot matrix impact printer from Seiko which can be connected to the Apple II. The Seikosha GP80 features precise graphics resolution, single and double width characters, full ASCII, upper and lower case, self-test program, 80 cpl (12 cpi), low power consumption — and is small enough to fit in a shoe box!

Electronic Concepts have also become the sole distributor for the Infoscribe range of printers from California. There are four models of serial dot matrix printers featuring full 136 column printing at 10 cpi, with a wide variety of print options and fully program-controlled forms handling. The Model 500, with a recommended retail price of $1840, is the basic model, followed by the Model 1000 at $2100, the Model 1500 at $2600 and the Model 2000 at $3200, all plus sales tax if applicable.

For further information on all these products contact Electronic Concepts Pty Ltd, 55 Clarence St, Sydney NSW 2000. (02)29-3753.

Natsemi price reductions

To reflect recent pricing decreases in RAM devices, National Semiconductor is now offering a 25% to 35% average price reduction on its RAM memory expansion boards.

In the 1 to 9 unit range, the RAM boards are priced as follows: BLC-8016 $565; BLC-8016A $655; BLC-8016B $872; BLC-032 $747; BLC-8032A $837; BLC-8032B $1113; BLC-048 $1024; BLC-8048B $1114; BLC-8084B $1482; BLC-064 $1210; BLC-8064A $1300; BLC8064B $1730.

Book Review

Apple Machine Language
By Don Inman,
$17-50

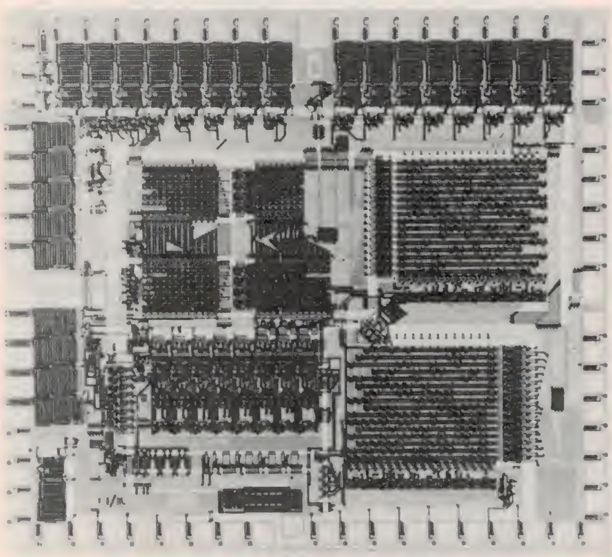
There has long been a need for a book such as this to introduce Apple users to the world of machine language programming. To date the only way to learn this subject was to obtain a self-teaching book on 6502, and while this was adequate for learning the instructions, most first-time users found it difficult to relate such information to their Apple monitor commands.

What was needed was a book which not only taught machine language programming to the person who had never even touched on the subject before, but also showed how to use this new programming method on the Apple.

This book seems to fill this gap very well indeed. It is easily understandable and does not assume any more than a modicum of knowledge in BASIC. Rather than attempting to teach machine programming by simply teaching the necessary instructions, the book introduces each section as a series of exercises which the user can try on his or her system. These cover such topics as sound generation, graphics usage and displaying text.

I would definitely recommend this publication to anyone who wishes a painless and interesting introduction to using 6502 machine language on an Apple II.

David Hanney
Computerland Sydney



Error detection and correction

A fast LSI device that detects and corrects errors from RAMs was announced recently by Intel Coproration.

The 8206 error detection and correction unit (EDCU) corrects single-bit errors and detects single, double and many multiple-bit errors as data is read from RAM. It is said to increase system reliability by a factor of at least 25. For example, in a typical microcomputer system with 128 kilobytes of RAM, the 8206 can extend that system's potential mean-time between failures (MTBF) from 1.4 years to 40.5 years.

Production quantities of the 8206 should be available from September through Intel sales offices and licensed Intel distributors. The US price for the part is US$62.50 each in quantities of 100.

For further information contact Intel Australia Pty Ltd, PO Box 571, North Sydney NSW 2060. (02)436-2744.

Printout

IMS answer to new sales tax problems

Many users of computer programs to handle their invoicing and accounting procedures may be having nightmares about the computer chaos caused by the recent changes to sales tax.

IMS claims to have a software support plan (SSP) which would overcome all these problems. Costing $500 per user per year, the plan covers the user for all legislative changes, such as in payroll or sales tax, as well as for later releases of all software in use. This in effect ensures that a customer's programs are at and will continue to be at the very latest level.

IMS Computer Systems say they have already released fixes to their programs to overcome the immediate sales tax problems, and have announced the methodology of implementing the changes when it is necessary. The cost for this will be a maximum of $200, but for customers participating in the SSP there is no additional cost.

The SSP also offers benefits such as a telephone query facility to the service desk, and discount training rates. Conversion programs are provided when substantial improvements require a change in the file structure, which avoids rekeying of data.

For more information contact IMS Computer Systems Pty Ltd, 582 St. Kilda Rd, Melbourne Vic. 3004. (03)51-9156.

Club Call

The Wollongong Computer Club is offering all interested people the opportunity to attend a course of instruction during which you will, with supervision, build your own computer — the ETI-660 (see ETI May, June and October 1981 and the article in this issue).

The offer is open to anyone in the community, and requires no previous knowledge of either computing or electronics; the course will start from the basic use of a soldering iron and take you through to the successful completion of your own colour computer.

The estimated cost of the course is $110, which includes the cost of the computer and the supervision and instruction while building, plus instruction in the use of the computer.

Features of the ETI-660 include:

- Colour
- Plugs into any TV and cassette player
- Easy to program
- Low cost
- Cassette and audio output
- Expandable
- Plus lots more!

If you are interested, contact Paul Janson at P.O. Box 297, Dapto NSW 2530 (042)61-5451. Other computer groups in the Wollongong area are the **NSW 6800 Users' Group**, 27 Georgina Ave, Keiraville NSW 2500, and the **Australasia ZX80/MicroAce Users' Group**, 87 Murphys Ave, Keiraville NSW 2500.

The **Tamworth BASIC Users' Group** is currently seeking information on TRS-80 (Level 2 and 3), Sorcerer, Ohio and Sinclair microprocessors, and wishes to make contact with the respective user groups. They are a small group of interested people concerned with programming, operation and systems design, from hobbyists to small business users.

The **Newcastle Microcomputer Club** has been active for a few years, and meetings are held on the second and fourth Mondays of each month at 7 pm in the Physics building of the University of Newcastle, room G12. Interested people may contact the group via Gordon Johnson, Electron Microscope Unit, University of Newcastle, NSW 2303, or by phoning Gordon Johnson on (049)68-5405 during business hours.

A **Sorcerer Computer Users' Group** has been formed in the Australian Capital Territory, and will be closely allied to the Victorian-based **Sorcerer Computer Users of Australia.** Interested persons should contact Mr. G.T. Dick, 31 Cresswell St, Campbell ACT 2601, (062)48-7793, for details of membership and information on forthcoming activities.

Tubeless CRT terminals

A tubeless CRT terminal developed by Synertek is now available from Royel Micro Systems, and offers a choice of formats.

The Model KTM-3 provides a 24-line x 40-character display, and operates with a low-cost monitor or TV. The KTM-3/80 delivers 24 lines x 80 characters, and operates with a high quality CRT monitor. Aside from the number of characters displayed, the units have identical technical features.

The terminals generate the full ASCII upper and lower case alphanumeric character set with descenders, using a 7 x 9-dot character matrix. Also available are control characters, scrolling, a blinking cursor, full cursor control, absolute and relative cursor addressing, automatic character repeat, and a shift lock key.

Further information is available from Royel Micro Systems, 27 Normanby Road, Notting Hil Vic. 3168, (03)543-5122, and 15/59 Moxon Road, Punchbowl NSW 2196, (02)709-5293.

1M-bit bubble memory

National Semiconductor Corporation has begun shipping prototype quantities of 1M-bit bubble memories and expects to begin volume shipments later this year.

National has been making volume shipments of 256K-bit magnetic bubble memory systems since November 1980, and recently introduced the smallest, densest five-chip support circuit set available in the marketplace today.

The company and its second sources are the only suppliers of bubble memory circuits and controllers able to offer a compatible 256K-bit and 1M-bit family of components, kits, boards and bubble memory subsystems.

National's three-year-old multimillion dollar memory programme has developed the smallest bubble memory devices available. A 1M-bit system is contained on a nine-square-inch card, or a full megabyte on an 81-square-inch standard BLC (Series 80/Multibus) board.

Pennywise three-card system

Australian designer Pennywise Peripherals can now offer a complete 64K 6809 disk-based system on just three pc boards.

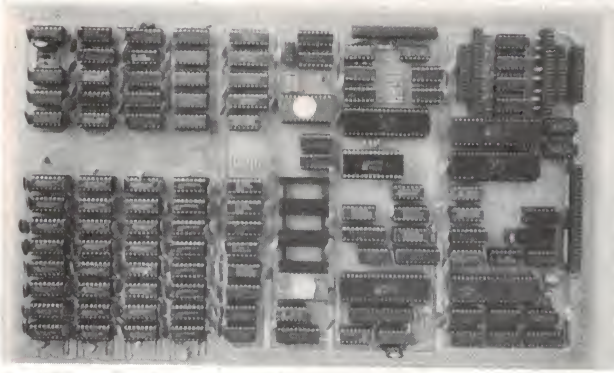
The release of their new 64K CMOS static RAM card, the M16-64, has completed the three-card system, and uses the latest 2K by 8-bit RAMs with an access time of 200 ns and very low power consumption.

The other two cards are the PMC-09 7809 Microcomputer Card, with memory mangement hardware essential for multiuser operation, and the FDCP-58 Floppy Disk Controller Card, which controls any mixture of 5" or 8" double-sided floppy disk drives.

This three-card system means that in a development system only three edge connectors are occupied, leaving plenty of space for development.

For more information contact Pennywise Peripherals, 96 Camberwell Rd, Hawthorn East Vic. 3123 (P.O. Box 398, Camberwell Vic. 3124). (03)82-2389.

Printout



'Big Board' computer kit has many features

Rod Irving Electronics is offering a Z80 CPU board with 64K of RAM and a huge variety of features for around $700.

Using 'industry standard' 4116 RAM chips, all 64K is available to the user — the video and EPROM sections of the computer do not use any of the system RAM. The Z80 CPU runs at 2.5 MHz and supplies all the 4116 RAM refresh signals, and is claimed to support mode two interrupts.

The basic I/O consists of a parallel port for use with an ASCII-encoded keyboard input; output is to standard 80 x 24 video display. The character set is supplied on a 2716-style EPROM and you can organise your own video configuration if you wish. A floppy disk controller is provided, IBM 3740-compatible, on board.

The 2K system monitor includes dump memory, CP/M boot, copy, examine, fill memory, test memory, goto, read and write, I/O, disk read and search, etc. The monitor does not occupy any of the system RAM.

Options you can obtain include serial I/O for synchronous and asynchronous communication; you can get RS232, and you can add a real time clock (Z80 CTC), four-bit parallel I/O and CP/M 2.2 Micronix Systems disk operating system.

Complete documentation is provided. You can obtain manual and assembly instructions for $15, refundable on purchase of the board, according to Rod Irving.

The 'Big Board' measures 216 x 350 mm and requires a power supply of +5 V at 3 A and −12 V at ½ A.

Further details from Rod Irving Electronics, 425 High St, Northcote Vic 3070. (03)489-1923.

Brisbane conference

The Institute of Engineers Aust., in association with the Australian Computer Society and the Institute of Radio and Electronics Engineers, will be hosting a conference on microprocessors in Brisbane from 17 to 19 November.

The venue is the Bardon Professional Centre in Simpsons Rd, Brisbane. An exhibition by major manufacturers and distributors will be held concurrently with the conference. Registration for members of the above societies for the full conference is $130. Details from the secretaries of the mentioned societies.

A free public session will be held on the 17th at the Bardon Centre, commencing at 7.30 pm. If you're going to be in Brisbane, don't miss it.

Disk-based system from Ritronics

Melbourne-based Ritronics are manufacturing a disk-based computer system featuring 1.2M (formatted) capacity, parallel and serial interfaces, CP/M 2.2, an 18 MHz green screen monitor and full-size keyboard.

The system features a Z80 CPU board with 64K of RAM, and Rod Irving has put it on the market for just under $3000 (plus tax), assembled and tested, with a 90-day warranty. A variety of software is available for the machine, including the popular Wordstar word-processing package. Documentation available with it even includes circuitry. Technical back-up is available for customers.

Full details can be obtained from Ritronics, 425 High St, Northcote Vic 3070. (03)489-7099.

Lothlorien Farming

Cultivating new concepts

PROUDLY PRESENT

THE CAVERNS OF MORDIA

Truly the most sophisticated computer game of adventure and strategy yet devised!

For the Apple II, II plus Computer
(48k & disk drive req'd.)

Dungeons	Dragons
Drop-offs	Dagger
Dwarf Trade	Sword
Passages	Mithril Armour
Ascent Shafts	Flares
Tunnels	Dragon Net
Maps	Charm Ring
Caving Reports	Dragon Occular
Teleportation	Orb of Power
Orcs	Tremors
Balrogs	Spider Web
Serpents	Holes
Vampire Bats	Evil Spirits
Goblins	Demon Curse
Giant Spider	Gold
Demons	Vitality Exchange
	Chests

Traps...and more!

- Different kind of combat with different monsters
- Complex combat/retreat with variety of equipment & situations
- Game can be interrupted & saved on disk for continuation later
- Game never repititious
  New Maps generated on re-start

Comprehensive, illustrated, 60 page Manual
Membership in the Caverns of Mordia Club
Disk, Manual & Club Membership $59 (Aust.)
(Postage & handling incl'd.)

Please specify: DOS 3.2 ☐ DOS 3.3 ☐
American Express ☐ Mastercharge ☐
VISA ☐ Bankcard ☐ Cheque ☐

Name ....

Address ....

Card No. ....

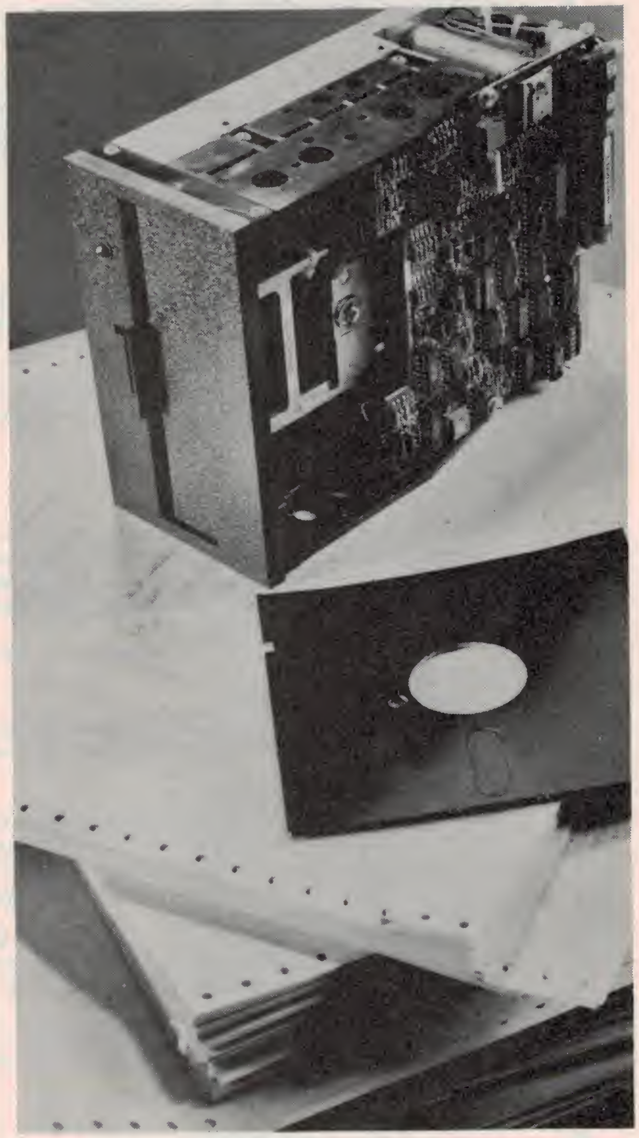
Expiry Date ....

Signature ....

Send to: Lothlorien Farming,
Box 1033,
GPO Sydney 2001,
Australia

MPI Hi-D Mini Drives

taking care of business



Just when you were convinced that only massive 8-inch drives could handle the big jobs, along comes **MPI Hi-D**, with up to 1 Megabyte capacity, 5 millisecond track-to-track, pushbutton media eject *and* head load for longer media and head life, all neatly squared away with the elegance and power efficiency of a 5¼-inch drive.

Need less storage? . . . MPI builds 40-, 77- and 80-track, single or double head 5¼-inch drives with the same classic 8-inch features.

Authorised Dealers:
Sydney: (02) E & M Electronics 51-5880, AED 632-6301, Applied Technology 487-2711. **Wollongong:** (042) Macelec 29-1455. **Newcastle:** (049) G.L. Electronics 69-5424. **Brisbane:** (07) Baltec 36-5183. **A.C.T.:** (062) Ortex 80-5283. **Perth:** (09) Micro Controls 325-2444. **Adelaide:** (08) Rogers Electronics 42-6666, Micro '80 211-7244. **Melbourne:** (03) Stewart Electronics 543-3733, Ellistronics 602-3282, Ritronics 489-8131, Pennywise Peripherals 82-2389.

daneva australia pty ltd.

66 Bay Road, Sandringham, Vic., 3191. Ph: 598-5622. Telex: AA34439

SN 781

For Sorcerer Apprentices

We'll start with a letter I received recently:

Dear Sir

I am most grateful for publication of those locations which address the entry points of the LOG, SIN, etc, subroutines of the BASIC PAC. I am pleased to supply you with information on how the floating point format is set up in locations 1BF through 1C2.

The exponent is stored in location 1C2 and the mantissa in 1BF through 1C1, with the most significant byte in location 1C1. The binary point is shifted to the leftmost position.

For example, the mantissa for 43.5 decimal is 2B.8 hex, which is 00101011.1 binary. This number will be stored in location 1C1 1C0 and 1BF as follows:

1010 1110 0000 0000 0000 0000

and we assume that the binary point is in front of that number. But since the digit to the far left of the mantissa is always 1 (because it was shifted until that was the case), then the sign can be stored in this bit without losing any information. If the number is positive or zero, then the sign bit will be 0; if negative, the sign bit will be 1.

Therefore the mantissa for 43.5dec:

1010 1110 0000 0000 0000 0000

changes to:

0010 1110 0000 0000 0000 0000

If the mantissa were negative, then the mantissa would not change.

The exponent is stored in location 1C2 and is calculated by adding the number of shifts to 80hex. If the shift is to the left the number will have a positive sign; if the shift is to the right, the sign will be negative. In the case of 43.5dec we shifted the binary point 6 places to the left, and therefore the exponent is 80+6=86. Now we can assemble the complete floating point number in the input/output buffer as follows:

86 2E 00 00

Exponent sign & mantissa

Implied point

Please note that the number is always in memory in reverse

In example 1 the decimal number 43.5 was entered in the buffer and a call was made via the monitor. After the call to location D4ABhex was completed, the program returned to the monitor. When inspecting the buffer the answer was 82 71 74 EBhex.

The conversion of the mantissa of the above answer into a binary number will give:

0111 0001 0111 0100 1110 1011.

This is a positive number and, as we remember from above, the most significant digit is always a 1. Therefore the actual number will be corrected to:

1111 0001 0111 0100 1110 1011

Since the exponent is 82 the binary point must be shifted two places to the right; the final result is therefore 3.C5 D3 AChex. Converting the number to decimal will give 3 + 12/16 + 5/256 + 13/4096 + 3/65536 + ... LAST FRACTIONS. Adding the number and fractions together we get 3.7728dec, which is correct.

In the example 2 the floating point number 82 00 00 00hex (2 decimal) was entered in the buffer. When a call to location D4ABhex (LOG) was carried out, the content of the buffer was 80 31 72 18hex or 0.6931 decimal.

Below are a few examples showing how the decimal number is converted and placed as a floating point number in the buffer of the BASIC PAC:

1196=	4AChex	= 8B 15 80 00
1=	1	= 81 00 00 00
−1=	−1	= 81 80 00 00
−0.5=	−0.8	= 80 80 00 00
0=	0	= 00 61 00 00

The only special case is the number 0; here the exponent is 00.

Example 1	Example 2
›EN 1BF	›EN 1BF
01BF: 00	01BF: 00
01C0: 00	01C0: 00
01C1: 2E	01C1: 00
01C2: 86	01C2: 82
01C3: /	01C3: /
›GO D4AB	›GO D4AB
›DU 1BF 1C2	›DU 1BF 1C2
01BF: EB 74 71 82 8F	01BF: 18 72 31 80

I hope this is enough information for your readers who want to make use of the subroutines resident in the BASIC PAC.

R. Perkuhn, Dapto

Well, 'R', thank you very much for all that information; I'm sure lots of readers will find it all extremely useful. Keep up the good work.

Now I'm going to get into some more ways to help you understand that wonderful little machine of yours. As mentioned in last month's issue, the Sorcerer is becoming more and more attractive for small business users and hobbyists alike, with an ever-increasing myriad of new programs appearing on the market. Most major programs are disk programs, and so the next section deals entirely with disk programs. Again, all information relates to the CP/M 2.2 operating system.

The main problem I encountered during my changeover to disks was the perplexity and vastness of information suddenly thrust upon me. What are BDOS, BIOS, FDOS, TPA, CCP etc. etc? Well, here goes:

BDOS: (Basic Disk Operating System). The BDOS handles all disk file management functions, such as opening a file, allocating free disk areas to files and keeping track of these areas. Since all this is quite complex, we are not interested in it, and so the BDOS does not normally echo anything to the screen; exceptions are error messages, such as disk full or disk r/o (read only).

BIOS: (Basic Input/Output System). Note that the word "basic" does not have any connections with the programming language. This is the part of CP/M which is customised to your own requirements. One can install special printer routines, a screen save routine or even a sort routine, all depending on the individual's requirements. The BIOS should however not be tampered with until a thorough understanding of the CP/M operations is reached.

FDOS: The memory area occupied by BDOS and BIOS. This area must remain intact during execution of programs accessing disks and can be found by checking bytes 6 and 7. These bytes point to the beginning of the BDOS (in reverse).

TPA: (Transient Program Area). Starting at location 100hex to FDOS. This is where your application programs will load. The TPA may extend into the CCP as long as the CCP will be rewritten for the next CCP access.

CCP: Console command processor. This area processes the commands you keyed in. If you use an inbuilt command, e.g: DIR‹CR›, CCP will not load any program but simply show the files on disk. If you key in PIP‹CR›, CP/M will load the program called PIP at the TPA and then jump to the TPA. One neat trick possible here is to save a zero length file (e.g: save 0 @.com‹CR›). Next time you want to run the same program twice, instead of loading it the second time, simply enter: @ ‹CR›; this will load 'nothing' into the TPA and jump to it! Try it with PIP. Not all programs will run a second time; such programs would have up- or down-loaders, and therefore their "goaddress" would not be 100h. You'll get to know which of your programs can be tricked this way and which cannot.

Lots more jargon is available for those of you already conversant with CP/M, but, as a beginner, that's all you really need to know. The more important thing is to recognise what the different type of files on your disk are meant to be. The first eight characters are unimportant. In the next section, we deal solely with the file-name's 'extension', the 3 characters after the point:

".$$$": Temporary CP/M files; erase them if you see any on your disk!

".ASM": Assembler file — an ASCII file containing Z80 or 8080 mnemonic instruction, to be converted by an assembler into a ".HEX" or ".REL" file.

".BAK": Backup file, created by programs like Spellbinder, Wordstar, etc.

".BAS": Basic file, either ASCII or non-ASCII.

".BCK": Backup files, created by 'Screen-saver'.

".C ": BDS C Source file — an ASCII file to be converted into a ".CRL" relocatable file.

New TeleVideo terminal

A new multi-lingual compatible and conversational terminal manufactured by TeleVideo has been released on the Australian market by Anderson Digital Equipment.

The new 910 conversational terminal is compatible with a range of other terminals, and allows the user to speak in English, French, Spanish or German by the use of strappable connections. Quality and legibility are also said to be improved.

ADE has developed a marketing strategy known as the 'Six-Pack Special', whereby purchasers buying lots of six get them for the price of less than five. The normal single-unit price is $995, but in lots of six the units are priced at $850 each — a total saving of $870 for the six units (this includes duty, but not sales tax).

Anderson Digital Equipment has branches and offices in every state, or may be contacted at P.O. Box 422, Clayton Vic. 3168. (03)544-3444.

New Fairlight releases

Fairlight's new word processor, the Lightwriter, is not a general microcomputer with a new software package, but a professional word processor designed from scratch. Both software and hardware have been developed especially for the needs of the office environment.

Amongst several innovative features is a lightpen, which provides text marking, movement or command selection on the face of the video screen. The operator points the pen at the desired line, word, paragraph or command word and touches it with the tip of the pen to activate it.

The Lightwriter also has a 15" screen, which gives a 50% larger character area than conventional 12" displays. This is claimed to result in a significant reduction in operator eyestrain and fatigue.

BASIC and various high-level languages are available, and the Lightwriter uses two 8" double-sided floppy disks, each capable of storing 200 pages of text. Two independent printers can be plugged into the Lightwriter, so that either high-quality documents or high-speed drafts can be selected without any switchover.

According to Fairlight, the Lightwriter is the first of a family of Australian-made word processing products, and pricing starts at $9000 plus printer. Due to its local construction, duty is not applicable.

Fairlight has also developed its QASAR single-user computer into a multi-user system, called the QASAR/VS, which is described as an entry-level system catering for one to four on-line users.

The new operating system design, commands and utilities are similar to those on the single-user QASAR, so that the latter now has a growth path; considerable effort has been made to maintain a high degree of commonality.

High-level languages include Pascal compiler and BASIC compiler with compatible interpreter, and FORTH is expected to be available by the end of the year.

When production units become available in November, it is expected that the system price will range from $10 000 to $16 000 plus terminals and sales tax. Fairlight also offers a two-year warranty, claiming to be the first supplier to do so.

Dragon to slay foreign competition

A new Australian-designed microcomputer, the Dyad Dragon, was recently launched in Melbourne by Professional Australian Systems, and is said to have been designed to meet the specific needs of Australian schools.

The designer, Mr. Bill Penrose, said that the Dragon should, "compete by price and quality against the best the overseas manufacturers can throw against us."

The Dragon is designed to meet any school's needs for both computer education and school administration, and because of its modular design it can be added to a school's existing hardware without the need for expensive modems, software or interface cards.

The basic system, which retails for under $2500, includes a CPU, card reader, automatic card hopper feed, 16K of RAM (upgradeable to 48K), video screen, keyboard and cassette interface. A cassette recorder, dual disk drives with 630K of information storage and printers are also available.

The Dyad Dragon is to be distributed in Australia by Zephyr Products, 70 Batesford Rd, Chadstone Vic.

".COM": command files. These files auto-execute when called from disk, e.g. PIP.COM.
".CRL": BDS C — relocatable file, to be converted into a ".COM" file by the BDS C linker-loader.
".DAT": Data files, any type of application.
".DIC": Spellcheck dictionary file.
".DOC": Documentation file; read them when you get new programs.
".EZY": Bob Stafford's EZYFILE data files.
".HEP": Spellbinder Help files, containing operating instructions.
".INF": Information file, same as ".DOC" files.
".INS": Instruction file, containing instructions on program operations.
".INT": C-Basic intermediate file.
".LEX": Microspell lexicon file.
".LIB": Library file, containing standard or customised routines, created with LIB or other programs.
".MAC": Macro-80 Source file, same as ".ASM".
".OVR": Wordstar overlay file, similar to ".COM" files, but loaded in different locations.
".PRN": Print file, created by assemblers.
".REL": Relocatable file, created by assemblers.
".SUB": Submit file, containing a batch of instructions.
".TXT": Text file, normally for demonstration.
".UTL": SID utility file.

I hope that helps all beginners with disks; that's all for this month.

A.P.F. Fry

Programming in CHIP-8 — a crash course

(what to do with your ETI-660 while you're learning how to do things with your ETI-660)

The 'language' used by our ETI-660 Learners' Microcomputer is called CHIP-8. It was developed by the designers of the 1802 microprocessor as an aid to writing small programs. Phil Cohen takes a look at CHIP-8 and gives a few programs for you to explore.

Phil Cohen

FIRSTLY, I should really tell you what CHIP-8 is *not*. It's not a high-level language like BASIC or even FORTRAN. Programs written in CHIP-8 are almost indecipherable to the casual reader. In that respect it is very much like 'machine code' — which is the 'language' that the microprocessor itself uses.

CHIP-8 is one step removed from that primitive machine code. What happens is this: you write a program in CHIP-8, and put it into an area of the ETI-660's RAM memory. Then you tell the microprocessor (by means of the built-in 'monitor' program located in IC11 that I'll also describe in this article) to go to the area of ROM memory that CHIP-8 resides in. The information in the CHIP-8 'interpreter' will tell the microprocessor how to do the CHIP-8 *program* that you've entered.

So why not write your programs in machine code in the first place and be done with it? Well, CHIP-8 offers some facilities (especially in input and output) that are difficult to design into a machine code program (especially for a first-timer).

If the last few paragraphs have 'lost' you, then don't worry. I'm just about to repeat myself in simpler terms.

When you turn on your ETI-660, the computer will be in the control of the 'monitor'. By operating the buttons on the unit, you can make the machine store a sequence of bytes of information in its memory.

Having done that, you then tell the monitor to hand over control to the CHIP-8 interpreter. The CHIP-8 interpreter follows the 'program' that you typed in using the monitor. The program can be anything from a TV game to a reaction timer.

How do you know what bytes of information to store in order to make the machine perform a particular series of actions? — that's easy. You read the rest of this article!

The monitor

Before I go on to the CHIP-8 interpreter proper, I'll just quickly cover the various commands that the monitor program is capable of understanding.

On the ETI-660, there is a RESET button. Now, no matter what happens, pressing the RESET button will get you back to the state where you were when the machine was first turned on. If after the monitor has passed control to the CHIP-8 interpreter, things start to go wrong (the thing gets into an endless loop, for example), then all you have to do is to press the RESET button and you'll be back in the monitor again.

Now, the first command that we'll cover is the **'Memory Inspect and Modify'** (MI&M for short). This command is started by pressing key **0**. The machine must just have been RESET.

When you press RESET, four digits will appear on the screen. This four-digit number is an 'address' — the number corresponds to a 'location' of RAM. Each 'pigeon hole' in the ETI-660 RAM memory has a four-digit number allocated to it.

In order to change the number on the screen, press key 0, followed by four digits.

Once you have done that, you can find out what the contents of the memory location are by pressing one of the STEP buttons (either one — they're connected in parallel). The two-digit number that appears is the value held in the location whose address you entered.

Pressing the STEP button again will show you the next location. Pressing it repeatedly will 'step' you through memory.

You can change the contents of any location by putting its address on the screen, and then entering the value that you want using the keyboard.

You can enter a series of values into successive memory locations by pressing STEP between entries. So to enter 12 into location 0600, 34 into 0601, and 56 into 0602, you would press RESET, then 0, then 0600, then STEP, then 12, STEP, 34, STEP, 56.

You can get out of MI&M mode by pressing RESET — this will not affect the values that you've put into memory.

The numbering system used is base 16, or hexadecimal ('hex' for short), rather than the more usual base 10 (which we were all taught at school). If you don't understand base 16, wait until the 'simple' series of articles on programming which will follow this 'crash course'.

So, after you've worked out what the various bytes of your CHIP-8 program are to be, you can enter them into memory using MI&M.

Once you have entered them, you can **pass control to the CHIP-8 interpreter** by pressing key **8** (after the machine has been RESET).

The CHIP-8 interpreter will look for the first CHIP-8 instruction at memory location 0600. The locations available to you to use for a CHIP-8 program are from 0600 to 07FF — that's over 500 locations.

Storing on cassette

Now, if you turn the machine off, you will lose the program that you just typed in. This is not good, especially if it happens by accident.

You can **store your program onto cassette** by the use of key number **2**. What you do is this: put the location at which the program starts into locations 0400 and 0401.

All your CHIP-8 programs will start at location 0600, so that means setting location 0400 to 06, and location 0401 to 00.

Similarly, set locations 0402 and 0403 to the end location of your program. 07FF should cover it. Press RESET, then start your cassette running and press button 2. As the ▶

STORING ON/LOADING FROM CASSETTE

To Store: Having typed in your program and got it running, you'll want to store (or save) it on cassette. Say the program runs from 0600 (in RAM) to 0725 — like the 'Target Practice' example later. First, press RESET, then press 0. Now,
press

'0400'
'STEP'
'06'
'STEP'
'00'
'STEP'

The address section in the bar at the bottom of the screen should now show '0402'. Continue with:

'07'
'STEP'
'25'

As a precaution, to avoid 'chopping off' the end of your program, you could make the last entry 'FF' if you like.

Then, press RESET. Connect up your cassette recorder — TAPE OUT to the 'mic' jack and TAPE IN to the 'ear' jack, and insert a fresh cassette. Set your cassette deck recording and:

press '2'

The speaker in the 660 will emit a series of outrageous noises. The TV screen will go blank, too. When the noise stops, STOP your cassette recorder. The TV screen will come back to life. Rewind your tape. Turn the power to the ETI-660 off briefly, then on again. Now you can try the next bit.

To load: Rewind your tape, if it isn't already rewound, or set it to the vicinity of the tape prior to where you recorded the program. You have to set the memory location 0400 to the start of the program (usually 0600) and 0402 to the end of the program — or beyond that (if you want to be safe). Taking the 'Target Practice' program:
press

'RESET'
'0'
'STEP'
'0400'
'06'
'STEP'
'00'
'STEP'
'07'
'25'
(or you could put 'FF' here)
'RESET'
'4'

The TV screen will go blank. Now start the cassette deck in PLAY. Set the volume control well up. Some experimentation with the volume control may be necessary to achieve a successful load. As the program is loaded, the speaker in the 660 will make funny noises. The TV display will come back on and the sound will stop when the load is finished. STOP the cassette deck. Press RESET and then 8 and your program is up and running!

Troubles: Your cassette deck should be in good condition, with clean unmagnetised heads properly aligned. If it cannot adequately record or reproduce 10 kHz then have it serviced or get another cassette deck. We recommend you also read 'Reliable Cassette Recorder For Your Computer' by Graham Wideman, September '81 ETI.

If all is OK with the deck, the record level may be too low. Listen to the tape once you've stored a program. The signal should be loud and with little or no background noise. If the record level is too low then reduce the value of R25. About 2k7 should more than cover it.

Most troubles with the cassette interface may be traced to head alignment or magnetisation problems, and unreliable connectors.

---

program loads, you'll hear an outrageous noise from the speaker. When the noise stops, stop the tape.

Putting your program onto tape is fine — but how do you get it off? Simple. Use key **4.** This **loads the taped program into memory**.

Press the RESET key, and then press key 4. Then set the cassette going. As the program is loaded in, the tone being put out by the ETI-660 will change. When the TV display comes back on, it's finished. Stop the tape.

There is a further command, key **6**, and this allows you to **execute a machine code program** at the address shown on the TV. However, the use of this is a little difficult. In other words, I haven't got room in this article to explain the 1802's instruction set, so I'll leave that one till later.

CHIP-8 proper

Fine. Now you're quite happy about what to do with your CHIP-8 program once you've written it. All you have to do now is to find out how CHIP-8 works. You use key 0 to enter it, then press key 8 to run it.

Each CHIP-8 instruction is two bytes long.

Take a look at Table 1. Don't expect to understand it, just take a look at it.

Looks complicated, doesn't it? Well, at first it is. But we'll split it into easily digestable chunks.

Before I tell you how the instruction set works, I'd better tell you how the table works. Each four-digit code in the leftmost column is one of the instructions. Now each instruction is two bytes long. That's four hexadecimal digits.

Taking the first instruction first (makes sense?), the code is 0MMM. Now this could be anything from 0000 to 0FFF. What I'm trying to get over by putting the Ms in is that where an M appears, you could have anything from 0 to F.

The mnemonic is just a way of showing the same thing in a more readable form. So the mnemonic for 0123 would be CALL 123. This would make the machine jump to a machine code subroutine at 0123 (the locations that it will jump to will always start with 0 because of the small size of the system).

So if you wanted to make the machine jump to a machine code subroutine (doesn't matter that you don't know what a subroutine is just yet) at location 0456, you would write CALL 456 down when you were planning your program, and when the time came to enter it into the machine, you would put in 0456.

By the way, as each instruction in CHIP-8 takes up two bytes, it takes two operations of the STEP key to input each full instruction.

So if the first instruction in the program (which, remember, starts at location 0600) was to be a CALL 456, then what you would do would be to press the RESET button, then press 0, then enter 0600, then press STEP, then enter 04, then press STEP again, then enter 56. And so on for the rest of the program.

Now I'll start describing the instruction set. I'll put the name of each instruction in **bold** type as I come to it, so that you can find it quickly later.

The first instruction is, of course, the **0MMM**. I've more or less covered this one — all that it does is to send the machine to a *machine code* routine. As I haven't told you how to write machine code routines, I'll leave it at that.

The next instruction is **1MMM**. This causes the CHIP-8 interpreter to jump to location 0MMM for the next instruction. Now normally, the interpreter will do the instructions in the order in which it finds them in memory, starting at location 0600, then 0602 (two locations per instruction, remember), then 0604, etc. But say you want it to go into a 'loop', repeating the instructions in locations 0600 to 0608 endlessly?

The answer would be to put an instruction in 0608 that causes the normal sequence of the 'execution' of the instructions to be changed. If you put a 1600 in location 0608 (and the mnemonic for this would be GOTO 600), then the machine would do the instruction in location 0600 at the start of the program, then 0602, then 0604, then 0606, then it would come to 0608. Following the GOTO instruction, the next one it would do would be 0600 again, followed by 0602, 0604, 0606, 0608, then back to 0600, 0602 ... and so on.

Of course, the GOTO instruction can not only make the interpreter jump *back* in the program — it can also make it jump forward.

Subroutines

The next instruction we come to is one of the most complicated. It's the **2MMM** instruction — the DO MMM.

Now what this tells the machine to do is similar to the effect of the GOTO MMM instruction. The difference is that, whereas when it got to a GOTO MMM, the computer goes where it's told, with a *DO* MMM it remembers where it jumped from. So for example, you might have a segment of program somewhere in memory that does something useful that you want to do quite often from different parts of the program. A program segment like that is called a subroutine (for historical reasons).

The DO MMM instruction allows you to send the machine out of the main part

of the program to the start of that subroutine, and a special instruction at the *end* of the subroutine will send it *back* once the subroutine is finished.

The special instruction is 00EE. So, for example, the following sequence will cause the subroutine to be done twice at different parts of the main program (the dots '...' mean various program instructions that aren't important to what I'm showing you):

location	code	mnemonic	comments	
0600	...			
...	...			
0610	2640	D0 640	first 'call';	main program
...				
0624	2640	D0 640	second 'call'	
...	...			
...	...			
...	...			
0640	...			
...	...			subroutine
0652	00EE	RET	sends it back	

TABLE 1 — CHIP-8 INSTRUCTION SET

CODE	MNEMONIC	FUNCTION
0MMM	CALL MMM	jump to a machine code subroutine at location 0MMM. The subroutine must end in a RET (D4)
1MMM	GOTO MMM	jump to location 0MMM (at which the next CHIP-8 instruction is to be found)
2MMM	DO MMM	jump to a CHIP-8 subroutine at location 0MMM. The subroutine must end in 00EE (which is the CHIP-8 equivalent of RET)
3XKK	SKIP IFVX=VKK or SKF VX=KK	skip the next instruction if variable VX holds the value KK
4XKK	SKIP IF NOT VX=KK or SKF VX=KK	skip the next instruction if variable VX does *not* hold the value KK
5XY0	SKIPIF VX=VY or SKF VX—VY	skip the next instruction if variable VX holds the same value as variable VY
6XKK	VX=KK	set variable VX to value KK
7XKK	VX=VX+KK	add KK to the value at present in VX
8XY0	VX=VY	set the value of VX to that in VY
8XY1	VX= VX OR VY	logical OR VX with VY, put the result into VX. Logical OR is like putting the two binary values through an OR gate bit by bit
8XY2	VX= VX AND Y	same as 8XY1, but logical AND
8XY3	VX= VX XOR VY	same, but with logical exclusive OR
8XY4	VX= VX + VY	add VX and VY, put the contents into VX. If there is an overflow, VF becomes 01, otherwise it becomes 00
8XY5	VX= VX − VY	subtract VY from VX and put the result into VX. If there is an underflow, VF becomes 00, otherwise it becomes 01
9XY0	SKIP IF NOT VX=VY or SKF VX=VY	skip the next instruction if the value of VX is not the same as that of VY
AMMM	I=MMM	set the value of the special 'memory pointer' variable I to 0MMM.
BMMM	GOTO MMM + V0	the value in variable V0 is added to 0MMM, and the machine will jump to the location whose address is the result of the addition
CXKK	VX = RND AND KK	produce a random byte, logical AND it with KK, and put the result into VX
DXYN	SHOW N AT VX, VY or SHOW N@VXVY	starting at the address held in the 'memory pointer' variable I, take N bytes out of memory and put them on the screen at a position VX from the left and VY from the top
EX9E	SKIP IF VX=KEY or SKF VX=KEY	skip the next instruction if VX is equal to the key being pressed
EXA1	SKIP IF NOT VX=KEY or SKF VX=KEY	opposite of EX9E
FX00	PITCH = VX	set the pitch(i.e: frequency)of the tone generator (beeper) to VX
FX07	VX = TIME	set VX to the current timer value
FX0A	VX = KEY	wait for a key to be pressed, then put the value of the key in VX
FX15	TIME = VX	set the value of the timer to VX
FX18	TONE = VX	set the duration of the tone burst (length of beep) to VX times 20 milliseconds (when VX is 50, it will be one second)
FX1E	I = I + VX	increase the value of the memory pointer by VX
FX29	I = DSPLY VX or I = DSP, VX	set the value of the memory pointer I so that when the next DXYN instruction is executed, the pattern shown will be the number that is the least significant digit of VX.
FX33	M(I)= DECML VX or MI=DEQ, VX	convert the value in VX to a three-digit decimal (base 10) number, and store the three digits in memory locations starting at location I (i.e: I, I+1 and I+2)
FX55	M(I)=V0:VX	put the values of variables V0 through VX into memory, starting with V0 at location I, V1 at location I+1, etc ... up to VX. Then increase the value of I so that it is I+X+1 (i.e: so that it points to the next location above the ones used for the variables)
FX65	V0:VX=M(I)	take the values of variables V0 through VX *out* of memory in the same way as the FX55 instruction. I becomes I+X+1. V0 comes out of location I.

When the machine got to 0610, it would immediately jump to 0640, then it would do 0640, 0642, 0644, ... and when it got to 0652, it would jump back to 0612 (the instruction *after* the one that 'called' it).

It would then go 0614, 0616, ... and when it got to 0624, it would again jump to 0640, go through the subroutine again, and when it got to 0652, it would jump back to 0626 — the instruction after the one that it was called from.

You can see that, by using this sort of thing, you can put in subroutines (sometimes called 'routines' for short) to do all sorts of useful things. They would of course have to be saved on tape with the main program.

Variables and loops

The next instruction is the 3XKK. Before I go too far into this one, I'll explain about the interpreter's **variables**.

Now the names of these variables are V0, V1, V2, V3 ... up to VF (there are sixteen altogether, and the second digit of the name of each of them is a hexadecimal one).

Each of these variables can 'hold' a value one byte long. That is, each of them can hold a value from 00 to FF.

Now the value of each of these variables can be changed at any time during a program. If you like, they're like sixteen little blackboards, each with a number written on it (from 00 to FF).

Each of the blackboards has a name — the first one is V0, the next V1 ... and so on up to VF.

Some of the instructions that the machine can execute allow new numbers to be written into the variables. Of course, when you write a new number in, the one that was there before will disappear (each blackboard can only hold one number at a time — I said they were *little* blackboards).

Other instructions allow the values in the variables to be read, added together, subtracted, etc.

So let's take a look at the **3XKK** instruction. What it says is "skip the next instruction if the value in VX is KK". The mnemonic is SKIP IF VX=KK, or if you want a shorter one (and a mnemonic is only for *your* convenience, the writer of the program), then another one is SKF VX=KK. ▶

Now the 'X' in 3XKK tells the machine *which* of the sixteen variables you're talking about. So 3245 would mean "skip the next instruction if variable V2 was equal to 45 (hex)".

The usefulness of this sort of instruction is in 'loops'. If you want to repeat a series of steps in a program a definite number of times, then you could set V2 (for example) to 0 at the start of the program, then do the sequence you wanted to repeat, then have an instruction that increased V2 by 1 (and we'll come to such an instruction later), then have a 3205 instruction.

The 3205 would skip the next instruction if V2 held the value 05. The instruction *after* the 3205 would be a GOTO MMM instruction which would send the machine back to the start of the sequence that was to be repeated.

So the first time the machine went through the sequence, V2 would be 00 until it got to the instruction to add 1 to it. It would then be 01, and when it got to the 3205, it would look at the value of V2 and see if it was 05. It wouldn't be (we've just shown that it would be 01), and so it would do the next instruction, which would be the GOTO.

That would send it back to the start of the repeated instructions (we say "back round the loop"). When it came to the instruction that added 1 to V2, it would leave V2 with the value 02.

See what's happening? Each time it goes round the loop, V2 increases in value by 1, until finally it gets to the value 05. *This* time, when it comes to the 3205 instruction, it would look at the value of V2, see that it *was* 05, and skip the next instruction (which is the GOTO). So it would *not* go round the loop again.

Effectively, what the 3205 instruction is doing is to tell the machine to repeat the loop 5 times.

Anyway, that's what the 3XKK instruction does.

The **4XKK** instruction does much the same, except that it will skip if VX is *not* equal to KK.

The **5XY0** compares the values of two variables, VX and VY. So a 5670 would skip the next instruction if the value in V6 was equal to the value in V7.

The **6XKK** sets VX to the value KK. If you like, this tells the machine to write the value KK on blackboard VX. 6789 would tell the machine to write the value 89 in variable V7. Another way of saying that is to say "set V7 to 89".

Increment/decrement

The **7XKK** is the one we mentioned earlier (honest) that allows you to *increase* the value held in VX by KK. So a 7201 would add 1 to the value stored in V2, and put the result back into V2. In other words, it would increase the value of V2 by 1. Another name for this is 'incrementing' (no, that's nothing to do with the police interrogations). We can say that the instruction *increments* V2.

The opposite of incrementing, by the way (*decreasing* the value of a variable by 1) is *decrementing*, and not excrementing.

Manipulations

The **8XY0** instruction sets variable VX to the value that is stored in VY. So if V2 was 03 and V4 was 89, an 8240 instruction would leave V2 at 89 and V4 at 89 also. (It's worth sitting down and thinking about that one).

The **8XY1**, **8XY2** and **8XY3** instructions are very similar. Each one of them takes the values in VX and VY, does something with them, and puts the result back into VX.

The 8XY1 does a logical OR on the two values. Now in order to explain this one, you have to convert the hex values that we usually work with back into binary.

Let's say that the value in V1 is 34, and the value in V2 is 9A. That gives them the following binary values:

variable	hex value	binary value
V1	34	00111000
V2	9A	10011010

Now what the 'logical OR' does is to take corresponding bits of the values of V1 and V2 and put them through an OR gate. Starting from the left, 0 OR 1 would give 1; 0 OR 0 would give 0; 1 OR 0 would give 1; and 1 OR 1 would give 1; and so on.

So the result would be 10111010, which in hex is BA. That's how it works. The usefulness of it is that for example, 40 OR 08 is equal to 48.

The logical AND (8XY2) works in much the same way, except that it puts the individual bits through an AND gate (metaphorically). The usefulness of that is that 48 AND F0 is 40; 48 AND 0F is 08.

The last one, 8XY3, gives a rather weird function (again bit by bit) called 'exclusive OR', or 'XOR' for short. What this says is that the result will be 1 if the inputs are different. So 1 XOR 0 is 1, but 1 XOR 1 is 0.

Plus and minus

The instruction **8XY4** is quite straightforward — the value in VX is added to the value in VY, and the result ends up in VX. But what happens when you try to add F0 to 42? The result (if you work it out by hand) would be 132 (hex). Now the result is going to go into VX, and VX will only hold two hex digits. So VX becomes 32, and VF (always VF, no matter what the values of X and Y are) is set to 01.

Of course, if the result is less than 100, VF is set to 00.

8XY5 is the same as 8XY4, except that the value in VY is *subtracted* from the value in VX. If the result is less than 00, VF is set to 00, but if the result is not less than 00, VF is made 01.

Skip to my loo

9XY0 is simply "skip the next instruction if the value in VX is not the same as the value in VY" — the opposite of the 5XY0 instruction.

You and 'I'

Now comes the time to introduce the 'memory pointer', **I**. This is the same as the rest of the variables V0 through VF, except that it can hold three hex digits (while they can hold only two).

It needs the extra room because it is used to hold the address of memory locations, and three hex digits is the smallest useful space in which that can be done.

The **AMMM** instruction simply sets the value in I to MMM, so that A123 would leave I holding the value 0123.

We'll come back to the I variable later.

Branches

BMMM is a strange one. What it says is "branch to the memory location which has the address of 0MMM plus the value of V0". So if V0 had the value 05, the instruction B610 would cause the machine to go to the instruction at location 0615.

This instruction is useful for accessing a series of short program segments arranged in a 'table' starting at 0MMM. As the value in V0 is changed, the jump will take the machine to different parts of the table. V0 is sometimes called the 'offset' and MMM the 'base' in this context.

Randomise

CXKK is a nice one. What it does is to produce a random byte (which the interpreter does all by itself), and then to AND this random byte with the value KK and put the result into variable VX.

So C234 will generate this random variable, from 00 to FF, then AND the random byte with 34. It's worth working out for yourself, but I can tell you right away that the *maximum* value of the result of that AND operation will be 34. The result is then put into V2.

So what the C234 instruction says is "set V2 to a random value between 0 and 34 (hex)".

Output and the screen

Now we come to some of the output instructions. These deal mainly with outputting information to the screen. The CHIP-8 program can, of course,

output to the screen directly by altering the memory locations which store the information that is to be displayed directly. (Each dot on the screen is one bit of memory, and the whole screen is stored in memory in a block starting at 0480). However, the CHIP-8 interpreter allows a much greater control over what's going on.

In the CHIP-8 interpreter, the screen 'locations' are split into 3F horizontally and 3F vertically. I'll explain that a bit further.

The **DXYN** instruction causes the machine to take N bytes out of memory, starting at the memory location whose address is given by the I pointer. So far, so good.

Now the DXYN causes the machine to put an image of these bytes onto the screen. What I mean by that is this: assume that the screen is blank to start with. Let's say that the DXYN is D321. So the number of bytes to be taken from the locations starting at I is 1.

Let's further say that the value of that one byte is 83. The binary for that is 10000011. The machine would put that binary image onto the screen by turning on one dot, then leaving the next five off, then turning on the next two.

By 'turning on a dot', I mean that a small part of the screen will go bright. The size of each dot is a few square millimetres (in fact, the numbers that you see when you turn the computer on are made up of these dots (also called 'pixels')).

Which part of the screen would this pattern appear in? That's where the XY part of the DXYN instruction comes in. X and Y refer to two variables. The first gives a number of dot widths across the screen, and the second gives a number of dot heights down the screen.

So let's say that the instruction was D321, and that V3 held the value 05 and V2 held the value 08. The first dot in the image would be five dots to the right and eight dots down from the extreme top left of the screen.

Now all this may seem unnecessarily complicated, but consider this: once you have set I to point at the image that you want (and set the relevant bytes of memory so that the dots you want in that image are right), changing the values held in VX and VY will make the image 'move' across the screen.

Another point I might bring to your attention is that, where the instruction is about to turn on a dot that's already on, it will turn it off. In fact, rather than saying 'turn the dot on', what I should have said was 'change the state of the dot'.

This means that the image that you put on the screen can be removed (set back to its original blank state) by executing the same DXYN instruction.

EX9E is an easy one. It skips the next instruction if the number on the key that you press is the same as the value in VX. This means that you can wait for a particular key to be pressed, ignoring all other keys, by making the instruction after the EX9E a jump back to the EX9E instruction (think about it).

EXA1 is the same as EX9E, except that it will skip if the key you press is *not* the one whose value appears in VX.

Play it, Sam

Another nice feature of the CHIP-8 interpreter is that it has a musical tone generator — the speaker in the machine can be made to emit a variety of musical notes.

The **FX00** instruction sets the pitch (frequency) of this tone. The X refers to one of the variables. So F200 would set the pitch of the tone generator to the contents of variable V2. The higher the value of the contents of the variable, the *lower* the pitch of the tone.

Once the PITCH variable (and it behaves just like a variable) has been set, all tones from the generator will be at that pitch until another PITCH=VX instruction is encountered (or the program ends).

Period

Yet another nice feature offered by the interpreter is the timer. This is like another variable, in that the one-byte value in it can be set to a given value, and the value in it can be used to set another V-type variable.

The difference is that the value in the timer variable will reduce by one every 20 milliseconds (one-fiftieth of a second) or so.

Having set the timer with a particular value (the time that you want the program to pause for, for example), you can then arrange to check to see if the period has ended by using the **FX07** instruction. This sets VX to the current timer value.

It's then a simple matter to use a 3XKK instruction to check the value in VX to see if it's zero, looping back to the FX07 instruction each time if it is not. The "RANDOM PITCH AND BLOCKS" example program later in the article uses this trick.

Pounding the keys

For keyboard input, the interpreter makes life really easy. The **FX0A** instruction waits for a key to be pressed, and then sets VX to the number on the key. Simple.

Remember I said that you could set the value of the timer? Well, **FX15** is how you do it. It sets the timer to the value of VX.

Having set the pitch of the tone, how do you make the thing sound? Well, the **FX18** does this. Not only does it set the tone off, it also allows you to set the length of time that it sounds for. One word of warning, however — the program will *not* wait for the end of the beep. That means that, if you want to produce a series of beeps (as in the "RANDOM PITCH AND BLOCKS" program), you have to arrange a timer loop so that the program will wait for the beep to finish before trying to do another beep. (If it does try to do another beep, the buzzer will be reset, and the second beep will override the first, making the first one very short).

Numbers

Remember the memory pointer? Well **FX1E** increases the value of I by the value of VX. This is useful if you want to display a large area of memory on the screen. You can move the I pointer through memory in steps of the value of VX.

The **FX29** instruction allows you to draw numbers on the screen without really thinking about it too much. What it does is to set the I pointer so that it just happens to be pointing at a block of memory which holds the *shape* of the number which is the right-hand digit of the value of VX.

To give an example, say that you want to display the number 9 at the top left hand corner of the screen. The following program segment will do just that:

mnemonic	code	comments
V1 = 09	6109	it's the right-hand digit we're interested in
V2 = 0	6200	
V3 = 0	6300	
I = DSPLY V1	F129	I will be pointing at the digit 9
SHOW 5 AT V2, V3	D235	It takes 5 bytes to show a number on the screen. This will show it at screen location 0, 0 — the top left hand corner.

You might like to try this segment on your machine; make the last code (after the D235) at 0000 — this will send it back to the monitor once it's finished. Try changing the values in V1, V2 and V3 to see what effect it has.

All this is fine — but what about games? Most people like to see scores, etc, in decimal, rather than in hex!

What the **FX33** instruction does is to take the value of VX and convert it to a three-digit decimal number (somewhere between 0 and 255). It then puts the result into the three memory locations which start with the one pointed to by I. (I is not altered). So location I becomes the 'hundreds', location I+1 becomes 'tens' and I+2 becomes 'units'. How do we get the values out of there? Later.

Now comes the time to introduce the concept of a 'stack'.

Stacks

When you jump to a subroutine (remember subroutines?) you might want to 'save' the values that are in the variables at present, so that you can go on using the same variables in the main program when the machine finishes the subroutine. So there should be some way of automatically saving the values of the variables in memory while the subroutine is going on, and then retrieving them afterwards.

A stack is a place in memory where the values in variables are kept for storage (at least, that's one of the uses for it).

The important thing about a stack is that, if *during the subroutine* you want to store some more variables, the stack can accommodate them.

It works like this: first, you set I to the start of an area of memory that you know is available (0700 is a good one). Then when you execute the **FX55** instruction, the machine will start by putting the value of V0 into memory at location I.

The value in I will then be increased by one. That's important — I'll tell you why later.

The next variable, V1, will be put into memory at the location *now* pointed at by I, then I is increased again. In fact, all variables starting at V0 and finishing at VX will be stored. So if the instruction is F355, variables V0, V1, V2 and V3 will be stored.

Notice that, at the end of this instruction, I will *still* be pointing at an *available* memory location (0703, in this example).

So if you now changed the values of some of the variables, you could do another FX55 and put these new values into memory at the locations after the old values. That's why it's called a 'stack' — the values are thrown into memory in the same way that a stack of magazines will pile up — one after the other.

Now in order to get the variables out, you would use the **FX65** instruction. First you would have to set I back to the start of the 'stack', then the FX65 would pull the variables out in the same order that the FX55 pushed them in.

The value of the memory pointer I is increased by the FX65 instruction in the same way that it is increased by the FX55 instruction. In fact, the FX65 is the way that we would get out of memory the results of the FX55 instruction.

The following example will take the value that V3 is set to, and display it *in decimal* at the top left of the screen:

mnemonic	code	comments
V3 = 80	6380	this is the value we're trying to display
V4 = 00	6400	
V5 = 00	6500	V4, V5 are the screen position — 00, 00 is the top left
I = 0700	A700	points to a free area of memory
M(I) = DECML V3	F333	this is the actual 'guts' of the program, and it puts the three 'results' digits at 0700, 0701 and 0702. I is still 0700.
V0:V2 = M(I)	F265	this takes the results out and puts them into V0 through V2 (which is why we used V3 to hold the input at the first line).
I = DSPLY V0	F029	ready to put the first digit on the screen
SHOW 5 AT V4, V5	D455	as per the last example
I = DSPLY V1	F129	next digit
V4 = V4 + 04	7408	moves the screen location along so that the next digit will not be on top of the first one
SHOW 5 AT V4, V5	D455	next digit is now on the screen
I = DSPLY V2	F229	last digit
V4 = V4 + 04	7404	move screen position again
SHOW 5 AT V4, V5	D455	last digit — finished!
	0000	returns control to monitor.

TARGET PRACTICE

```
0600  67 19  V7=19
0602  68 00  V8=00
0604  26 C2  DO 06C2
0606  26 DE  DO 06DE
0608  65 25  V5=25
060A  66 0D  V6=0D
060C  26 E6  DO 06E6
060E  D5 65  SHOW 5MI@V5V6
0610  CD 01  VD=RND
0612  3D 01  SKF VD=01
0614  6D 07  VD=07
0616  27 0C  DO 070C
0618  64 10  V4=10
061A  63 0B  V3=0B
061C  83 D4  V3=V3+VD
061E  A6 BF  I=06BF
0620  D3 41  SHOW 1MI@V3V4
0622  6C 00  VC=00
0624  6B 80  VB=80
0626  60 03  V0=03
0628  E0 A1  SKF V0≠KEY
062A  6B FF  VB=FF
062C  60 06  V0=06
062E  E0 A1  SKF V0≠KEY
0630  6B 00  VB=00
0632  60 09  V0=09
0634  E0 A1  SKF V0≠KEY
0636  6B 01  VB=01
0638  3B 80  SKF VB=80
063A  26 9A  DO 069A
063C  A6 B3  I=06B3
063E  D5 65  SHOW 5MI@V5V6
0640  85 94  V5=V5+V9
0642  86 A4  V6=V6+VA
0644  45 20  SKF V5≠20
0646  26 F6  DO 06F6
0648  45 3B  SKF V5≠3B
064A  26 FA  DO 06FA
064C  46 00  SKF V6≠00
064E  26 FE  DO 06FE
0650  46 1B  SKF V6≠1B
0652  27 08  DO 0708
0654  D5 65  SHOW 5MI@V5V6
0656  3F 00  SKF VF=00
0658  16 80  GO TO 0680
065A  4C 00  SKF VC≠00
065C  16 24  GO TO 0624
065E  A6 BF  I=06BF
0660  D3 41  SHOW 1MI@V3V4
0662  33 3E  SKF V3=3E
0664  16 6E  GO TO 066E
0666  47 00  SKF V7≠00
0668  16 68  GO TO 0668
066A  27 0C  DO 070C
066C  16 10  GO TO 0610
066E  73 02  V3+02
0670  44 00  SKF V4≠00
0672  6B 01  VB=01
0674  44 1D  SKF V4≠1D
0676  6B FF  VB=FF
0678  84 B4  V4=V4+VB
067A  D3 41  SHOW 1MI@V3V4
067C  4F 00  SKF VF≠00
067E  16 3C  GO TO 063C
0680  60 02  V0=02
0682  F0 18  TONE=V0
0684  A6 BF  I=06BF
0686  D3 41  SHOW 1MI@V3V4
0688  A6 B3  I=06B3
068A  D5 65  SHOW 5MI@V5V6
068C  26 DE  DO 06DE
068E  78 0A  V8+0A
0690  26 DE  DO 06DE
0692  47 00  SKF V7≠00
0694  16 94  GO TO 0694
0696  27 0C  DO 070C
0698  16 08  GO TO 0608
069A  6C 01  VC=01
069C  60 07  V0=07
069E  F0 18  TONE=V0
06A0  26 C2  DO 06C2
06A2  77 FF  V7+FF
06A4  26 C2  DO 06C2
06A6  00 EE  RET
06A8  01 7C
06AA  7C FE
06AC  7C 7C
06AE  70 7C
06B0  38 7F
06B2  7F 7C
06B4  7C 7C
06B6  7C 7C
06B8  38 38
06BA  38 38
06BC  38 3E
06BE  E0 80
06C0  00 D4
06C2  A7 F8  I=07F8
06C4  F7 33  MI=V7(3DD)
06C6  6E 1B  VE=1B
06C8  6F 10  VF=10
06CA  F2 65  V0:V2=MI
06CC  F0 29  I=DSP,V0
06CE  DF E5  SHOW 5MI@VFVE
06D0  6F 15  VF=15
06D2  F1 29  I=DSP,V1
06D4  DF E5  SHOW 5MI@VFVE
06D6  6F 1A  VF=1A
06D8  F2 29  I=DSP,V2
06DA  DF E5  SHOW 5MI@VFVE
06DC  00 EE  RET
06DE  A7 F8  I=07F8
06E0  F8 33  MI=V8(3DD)
06E2  6E 00  VE=00
06E4  16 C8  GO TO 06C8
06E6  C9 01  V9=RND
06E8  39 01  SKF V9=01
06EA  69 FF  V9=FF
06EC  CA 01  VA=RND
06EE  3A 01  SKF VA=01
06F0  6A FF  VA=FF
06F2  A6 B3  I=06B3
06F4  00 EE  RET
06F6  69 01  V9=01
06F8  16 EC  GO TO 06EC
06FA  69 FF  V9=FF
06FC  16 EC  GO TO 06EC
06FE  6A 01  VA=01
0700  C9 01  V9=RND
0702  39 01  SKF V9=01
0704  69 FF  V9=FF
0706  00 EE  RET
0708  6A FF  VA=FF
070A  17 00  GO TO 0700
070C  6E 08  VE=08
070E  A6 A9  I=06A9
0710  DD EF  SHOW FMI@VDVE
0712  7E 0F  VE+0F
0714  A6 B8  I=06B8
0716  DD E6  SHOW 6MI@VDVE
0718  6E 10  VE=10
071A  60 08  V0=08
071C  80 D4  V0=V0+VD
071E  8F 00  VF=V0
0720  A6 BE  I=06BE
0722  DF E2  SHOW 2MI@VFVE
0724  00 EE  RET
```

Shoot by pressing key 3 (up), 6 (straight), or 9 (down) to hit the moving target. The bottom number shows the number of shots. Each hit scores 10 points (tip number).

You can try playing about with the values in V3, and also in V4 and V5 — remember that V4 is increased from its *original* value, so making it a different value to start with will move all three digits (which is just what we want).

Miscellaneous

We've covered (phew!) all of the instructions in the table so far — but there are a few others which are actually 'machine code' subroutines built into the ROM (but don't let that stop you using them):

code	function
0000	return to monitor
00E0	clear the screen
00EE	return from CHIP-8 subroutine
00F8	turn the screen on
00FC	turn the screen off (i.e: display a blank)
00FF	do nothing

A word of explanation about these — **00FC** will cause the screen to go blank until a **00F8** is executed. This allows you time to write things on to the screen — and then turn it on all of a sudden.

However, **00E0** clears all of the dots from the screen — makes it blank until you turn some of the dots back on.

0000 is a good one — it just finishes the program and sends you back to the monitor. For programs which do something and then stop, this is very useful.

Now, **00FF** may seem a bit useless. But it's an instruction that you will probably end up using more than any other. The reason for this is that, with a long program, if you want to put in one or two extra instructions to make the program work the way you want to, you will have to change the locations of all the program from there on. However, if you put in a few 00FFs at various points in the program, you can get away with re-entering only a small part of the program.

Similarly, any instructions that you want to take out can be replaced by 00FFs. All a 00FF does is to send the machine to the next instruction.

RANDOM PITCH AND BLOCKS

address	mnemonic	code	comments
0600	V0 = V8	6008	this is the variable which holds the timer initial value
0602	V1 = RND AND FF	C1FF	sets V1 to a random value between 00 and FF
0604	PITCH = V1	F100	sets the frequency of the tone to the random value
0606	TIME = V0	F015	load timer with 08
0608	TONE = V0	F018	make a tone of the same length as the timer period
060A	V2 = TIME	F207	sets V2 to the current timer value so that it can be kept an eye on by the next instruction
060C	SKF V2 = 00	3200	skip the next instruction if the timer has reached 00
060E	GOTO 060A	160A	loop back to wait for the timer if it's not finished yet
			Now for the blocks on the screen ...
0610	VA = RND AND 37	CA37	sets VA to somewhere between 00 and 37
0612	VB = RND AND 37	CB37	sets VB to somewhere between 00 and 37
0614	I = 61A	A61A	sets I to the end of the program (where there is spare memory)
0616	SHOW 7 @ VA, VB	DAB7	puts the block at I onto the screen at the random position VA, VB
0618	GOTO 0600	1600	go and do it all again ...
061A ...	0620:		these locations will hold the 'pattern' that will end up on the screen. (Try filling them with FFs).

SONG IN THE KEY OF YALE

address	mnemonic	code	comments
0600	I = 0622	A622	set the memory pointer to the 'data' area
0602	V1 = 0F	610F	
0604	V0 = FF	60FF	
0606	V0 = V0 + 01	7001	this will set V0 to 00 the first time through (the result of the addition will be 100, and the first digit will end up in VF).
0608	V0 = V0 AND V1	8012	this makes sure that V0 is between 00 and 0F (if you like, it 'masks' out the left-hand digit.
060A	SKF V0 = KEY	E09E	V0 is busy being the numbers from 00 to 0F one by one — when you press a key, this loop will try all of the possible values until V0 matches the key.
060C	GOTO 0606	1606	loop back and try the next value of V0
060E	V2 = 08	6208	
0610	I = I + V0	F01E	points I at one of the locations between 0622 and 0632, depending on what V0 is (and therefore on what key was pressed)
0612	V0:V0 = M(I)	F065	this loads the value in the memory location pointed to by I into V0
0614	PITCH = V0	F000	... and this is why — each location from 0622 to 0630 holds the pitch which corresponds to that key
0616	TIME = V2	F215	
0618	TONE = V2	F218	set up the timer and the beeper for a beep of length V2 (which is 08).
061A	V2 = TIME	F207	set V2 to keep an eye on the time
061C	SKF V2 = 05	3205	let the timer go until it gets to 5, then look for the next note (if there is none, it will sound for 100 milliseconds after the key is released).
061E	GOTO 061A	161A	keep looking at the timer ...
0620	GOTO 0600	1600	next key
0622	data	8071	these locations hold the required pitch settings for C major — perhaps you can change them to get sharps and flats?
0624		655F	
0626		544B	
0628		433F	
062A		3832	
062C		2F2A	
062E		2521	
0630		1F1C	

Examples

The first example is instructive rather than useful. What it does is to write blocks of dots on the screen, at the same time playing a sequence of notes of random pitch and duration.

If you run this program, you will find that the 'blocks' do not appear at a truly random position, but that they fall into 12 areas on the screen. This is because finding a random value and then ANDing it with the limiting value (37, in this case) does not provide a completely linear distribution. Work that one out for yourselves — maybe you could find a way of putting the blocks on the screen randomly? (Clue: you might have to use the 8XY5 instruction).

The next example is a little more advanced — what it does is to turn your keyboard into a piano! As you press the keys, you will hear notes played in the key of C major.

A game — and colour

Included here is another, longer, example — a fully-fledged game called 'Target Practice'. It hasn't got the same level of commenting as the previous examples, so that leaves you to work out for yourself how it works internally.

The fully-optioned ETI-660 is capable of producing colour on screen — I haven't covered that this time because of lack of space, but we'll get to it later.●

"You'll have a shandy, then? ..."

Tom Moffat

39 Pillinger Drive, Ferntree Tas. 7101

Imagine this scenario: a man walks into his local computer shop intending to buy a printer. A few minutes later he's made his selection. The salesman wraps it up and hands it to the buyer, who then carts it down the stairs and out the front door. Strapping the printer parcel to the handlebars of his bike, he heads off home ...

IT'S NOT FICTION; that's exactly how the Sharp CE-122 dot impact printer fell into this writer's hands. This printer would probably qualify as the smallest on the market at the time of writing. It's designed to mate with the Sharp PC-1211 pocket computer, and, unofficially, with the Tandy pocket TRS-80.

A previous article on pocket computers (ETI Jan. 1981) pointed out that although neither Sharp nor Tandy had a printer available for their products, the computers had the appropriate control lines brought out for printer control. Now Sharp at least has released the printer, and it works equally well with either the Sharp or Tandy computer, which for all practical purposes are the same machines.

It appears that Tandy aren't ready to release a printer for their pocket TRS-80. After several approaches to them they'd only say it was under consideration, and when told that Sharp already had one out that worked very nicely with the Tandy computer, their only response was "no comment". So for the moment we'll look at the Sharp printer/Tandy computer combination — maybe we should call it the 'Shandy'!

Printer design

The physical design of the CE-122 is much along the lines of the Sharp/Tandy cassette interface. It forms a cradle into which the computer is inserted, making contact with a plug at the computer's left hand end. The

printer mechanism itself is in an extension to the interface's normal length, adding about 75 mm to the left hand end. Near the back is a compartment which holds a tiny roll of paper (it looks like a small roll of cash register tape). The paper is nothing special and is therefore quite cheap (about 28 cents a roll). Another little cover on top opens to reveal a tiny nylon ribbon in an endless cartridge, said to be good for about 10 000 lines of print.

You can see the printing going on through a little window, and completed copy rolls up through a slot in the top, which has a serrated edge for tearing the paper off.

Below the slot is a row of controls: a LED that flashes when the printer's rechargable battery is low, a button to advance the paper, a switch to override tape motion control in the cassette interface, a switch to enable the printer, and a power switch for the whole unit.

The cassette interface is much like the one supplied separately, although the one in the printer unit seems to be less sensitive to input level variations than the free-standing interface.

The printer mechanism works in a most unusual way; instead of printing each character in one hit and then advancing to the next one, it prints the top row of dots of a line of characters, then jumps down and does the next line, and then does it again and again until a complete line of 5 x 7 matrix characters is printed.

Information to be printed is supplied by the computer simply as a burst of serial data. The printer has its own CPU, a printing control chip, and a 1K RAM to store the data, convert it to the proper format, and control the action of the print head. In fact the printer seems to have nearly as much electronics in it as the computer itself.

Because it gets the data transfer over quickly, the computer is able to get on with its main task while the printer is sorting out the print data. The computer therefore sometimes asks for new input data on its liquid crystal display while previous computation results are still being printed.

The computer gets into the print mode in a very sneaky way ... and I spent untold hours trying to crack it before the printer came on the market.

But how?

The usual Tandy 'LPRINT' results in a syntax error; so does APRINT, BPRINT, CPRINT, DPRINT, and every other combination you can think of. The print mode is in fact selected by pressing the break key twice (now whoever would have thought of that!). Knowing how to get the computer to spit the data out, I'd like its serial port to allow one to use another computer to generate print data for a conventional teletype machine (I'm working on it).

In the 'Shandy' system, when the print mode is selected print statements no longer come up on the LCD display; instead they come up on the printer, sixteen characters to a line, and if the statement is more than sixteen characters long it simply continues on the next line, breaking a word in half if necessary. However, if the programmer formats the print statements with extra spaces to prevent word splitting, the result looks quite presentable.

The list function is done in two different ways. If you type in 'LIST 10' or any list with a line number, the line in question appears on the LCD display in the normal way. But if you type 'LIST' with no line number, the computer will proceed to output every line in its memory to the printer. It uses a special format: first the line number on the left of the paper, then the contents of the line. If the line length runs longer ▶

WOULD YOU BELIEVE IT? — This arrived the day we went to press!

TANDY ELECTRONICS
NEWS RELEASE

FOR FURTHER INFORMATION CONTACT
Mal Williams
TRS-80 Merchandising Mgr.

Tandy Corporation (Australian Branch)
280-316 Victoria Road, Rydalmere, 2116
Sydney, Australia
P.O. Box 229 Telex: Tandy 2542[illegible]
Telephone: 638 663[illegible]

DATE: 1st October, 1981
RELEASE NO: TC-811001-DH
SUBJECT: Pocket Printer

Pocket Printer Now On Sale

Tandy Electronics, manufacturers and retailers of the world's largest-selling little computer - the TRS-80, have released a minature printer and cassette interface combination to suit the widely-acclaimed TRS-80 Pocket Computer.

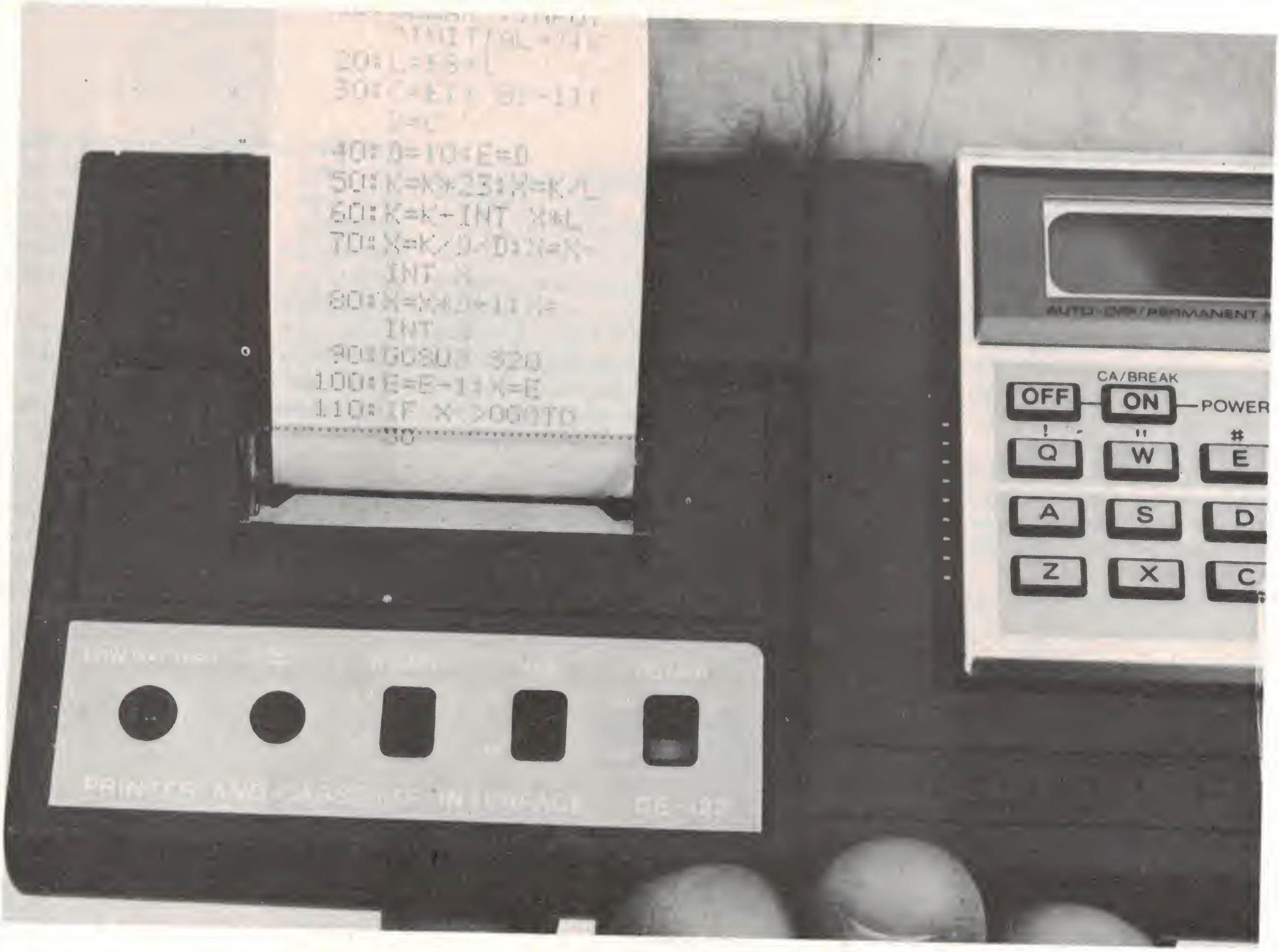
The tiny printer outputs 16 alpha-numeric characters per line, with automatic "wrap-around" of lengthy text to the next line. Data printouts and programme listings are printed in easy-to-read dot matrix characters.

The built-in cassette interface allows programmes and data to be dumped to and loaded from cassette tape with a suitable recorder, such as the Minisette-9 Ultra Slim Cassette Recorder (Cat No. 14-812, $89.95).

The Printer/Cassette Interface (Cat. No. 269-3505) retails for $149.95 complete with rechargeable batteries and a mains adaptor/charging unit. Also included is a ribbon cartridge, three rolls of paper, cassette cable and manual.

The TRS-80 Pocket Computer, Printer/Interface and Minisette Cassette Recorder combine to make a useful tool for architects, engineers, accountants or salesmen who need a small system to fit in a briefcase or handbag. The Pocket Computer can handle many of the tasks carried out on desktop-sized microcomputers, and its' versitality is further enhanced by hard-copy printout and cassette data and programme storage.

These products are available from and Tandy TRS-80 Computer Centre or through any of nearly 300 Tandy Stores and Dealers throughout Australia.



than 16 characters, printing continues on the next line; four spaces are first added to line numbers so they appear in one column, and line contents stay in their own column. This makes for a very neat and easy to read list.

Any program written for the computer in the normal way will work with the printer, with PRINT statements being printed and PAUSE statements appearing on the LCD display. But re-writing a program to take advantage of the printer's format makes for a much nicer result.

To demonstrate this we've included two versions of a spacecraft landing program, originally translated from the one included with Tandy's TRS-80 Level 2 BASIC manual. The first version is designed for the pocket computer only, without a printer; the second has had a few changes made to take full advantage of the printer. The program gives a choice of four bodies to attempt a landing on, with gravity effects appropriately modified for each.

It also takes into account the reducing weight of the spacecraft as fuel is consumed. The 'fuel' burn is entered as a percentage of maximum thrust, from 0 to 100, and the result of the landing is displayed with the appropriate comments. Have fun! ●

SPECIFICATIONS:
SHARP CE-122 PRINTER.
Columns: **16**
Dot structure: **5 x 7 matrix**
Print speed: **approx. one line per second**
Battery life: **about 8000 lines per charge**
Recharging time: **about 15 hours**
Power consumption: **1.84 watts**

PRINTER VERSION

```
  5:CLEAR
 10:PRINT " ":
    PRINT "SPACE
    SHIP LANDER"
 20:PAUSE "ENTER
     DESTINATION
    ..."
 30:INPUT "EARTH
    ,MOON,MARS,V
```

```
230:Q=Q-JH:W=G
240:I=L+LP/-2E-J
    0/(C+Q)
250:G=F+IH:R=P
260:P=P+(G+F)/A*
    H:F=G
270:IF P<0THEN 3
    30
```

LCD DISPLAY VERSION

```
  5:CLEAR
 10:PAUSE "*** S
    PACESHIP LAN
    DER ***"
 20:PAUSE "ENTER
     DESTINATION
    ..."
```

```
     0LET H=T
230:Q=Q-JH:W=G
240:I=L+LP/-2E-J
    0/(C+Q)
250:G=F+IH:R=P
260:P=P+(G+F)/A*
    H:F=G
```

```
   ESTA:",S$
 32:PRINT "* DES
    TINATION *"
 34:PRINT " > >
    ";S$;"! < <"
 40:IF S$="EARTH
    "LET K=980.7
    :E=6371:GOTO
    90
 50:IF S$="MOON"
    LET K=162:E=
    1738:GOTO 90
 60:IF S$="MARS"
    LET K=374:E=
    3380:GOTO 90
 70:IF S$="VESTA
    "LET K=17.5:
    E=195:GOTO 9
    0
 80:PAUSE "NAV.
    ERROR--TRY A
    GAIN":GOTO 3
    0
 90:PRINT " GRAV
    ITY=";USING
    "####.#";K
 92:PRINT " ":
    PRINT " HGT
     VEL  FUEL"
100:L=K/36:M=INT
    (√L*E2)
110:IF M<175LET
    M=175
120:N=INT (55M)
130:IF N<E4LET N
    =E4
140:O=N*LN K/20+
    E4
150:A=-6.4E3:B=5
    E3:C=1.5E4:D
    =E1
160:H=D:F=B:P=M:
    Q=N
170:PRINT USING
    "####";P;
    USING "#####
    ";F;USING "#
    #####";Q:
    GOTO 190
180:PRINT USING
    "##.##";P;
    USING "####.
    #";F;USING "
    #####";Q
190:INPUT "ENTER
     PERCENT POW
    ER:";J
195:USING :PRINT
    "   BURN=";J
200:IF J=0THEN 2
    30
210:IF (J<0)+(J>
    100)THEN 310
220:T=Q/J:IF T<1
    0LET H=T
```

```
280:IF Q<=0THEN
    320
290:IF (P<10)*(F
    <E3)THEN 180
300:GOTO 170
310:PAUSE "ILLEG
    AL BURN, USE
     0-100":GOTO
    190
320:X=√(FF+5650P
    L):PRINT "OU
    T OF FUEL!":
    GOTO 340
330:X=√(ABS (R/2
    6I))*I+W
340:BEEP 1:PRINT
    "YOU HAVE...
    "
350:IF X<20PRINT
    "LANDED OK."
    :GOTO 400
360:IF X<100
    PRINT "CRASH
    ED.":GOTO 42
    0
370:IF X<250
    PRINT "BEEN
    BLOWN UP.":
    GOTO 450
380:IF X<5000
    PRINT "MADE
    NEW CRATER."
    :GOTO 450
390:IF X>4999
    PRINT "BEEN
    VAPORIZED.":
    PRINT "*** B
    OOM!!! ***"
400:IF X<1PRINT
    "NICE TOUCH-
    ":PRINT "VER
    Y GOOD!":
    GOTO 450
410:IF X<5PRINT
    "A BIT ROUGH
    ...":GOTO 45
    0
420:IF X<30PRINT
    "UNABLE TAKE
     OFF.":GOTO
    450
430:IF X<45PRINT
    "LANDER ON F
    IRE.":GOTO 4
    50
440:PRINT "THERE
     ARE":PRINT
    "NO SURVIVOR
    S."
450:PRINT "IMPAC
    T VELOCITY="
    :PRINT USING
    "#####.##";X
460:USING :GOTO
    10
```

```
 30:INPUT "EARTH
    ,MOON,MARS,V
    ESTA:",S$
 40:IF S$="EARTH
    "LET K=980.7
    :E=6371:GOTO
    90
 50:IF S$="MOON"
    LET K=162:E=
    1738:GOTO 90
 60:IF S$="MARS"
    LET K=374:E=
    3380:GOTO 90
 70:IF S$="VESTA
    "LET K=17.5:
    E=195:GOTO 9
    0
 80:PAUSE "NAV.
    ERROR--TRY A
    GAIN":GOTO 3
    0
 90:PAUSE S$;" G
    RAVITY=";
    USING "####.
    #";K
100:L=K/36:M=INT
    (√L*E2)
110:IF M<175LET
    M=175
120:N=INT (55M)
130:IF N<E4LET N
    =E4
140:O=N*LN K/20+
    E4
150:A=-6.4E3:B=5
    E3:C=1.5E4:D
    =E1
160:H=D:F=B:P=M:
    Q=N
170:PRINT "H";
    USING "####.
    #";P;"; V";
    USING "#####
    ";F;"; F";
    USING "#####
    #";Q:GOTO 19
    0
180:PRINT "H";
    USING "##.##
    #";P;"; V";
    USING "####.
    #";F;"; F";
    USING "#####
    ";Q
190:INPUT "ENTER
     PERCENT POW
    ER:";J
200:IF J=0THEN 2
    30
210:IF (J<0)+(J>
    100)THEN 310
220:T=Q/J:IF T<1
```

```
270:IF P<0THEN 3
    30
280:IF Q<=0THEN
    320
290:IF (P<10)*(F
    <E3)THEN 180
300:GOTO 170
310:PAUSE "ILLEG
    AL BURN, USE
     0-100":GOTO
    190
320:X=√(FF+5650P
    L):PAUSE "OU
    T OF FUEL!":
    GOTO 340
330:X=√(ABS (R/2
    6I))*I+W
340:BEEP 1:PAUSE
    "YOU HAVE...
    "
350:IF X<20PAUSE
    "LANDED OK."
    :GOTO 400
360:IF X<100
    PAUSE "CRASH
    ED.":GOTO 42
    0
370:IF X<250
    PAUSE "BEEN
    OBLITERATED.
    ":GOTO 450
380:IF X<5000
    PAUSE "MADE
    A NEW CRATER
    .":GOTO 450
390:IF X>4999
    PAUSE "BEEN
    VAPORIZED.**
    BOOM!!!":
    GOTO 450
400:IF X<1PAUSE
    "NICE TOUCH-
    -VERY GOOD!"
    :GOTO 450
410:IF X<5PAUSE
    "A BIT ROUGH
    ...":GOTO 45
    0
420:IF X<30PAUSE
    "UNABLE TO T
    AKE OFF.":
    GOTO 450
430:IF X<45PAUSE
    "LANDER IS O
    N FIRE.":
    GOTO 450
440:PAUSE "THERE
     ARE NO SURV
    IVORS."
450:PRINT "IMPAC
    T VELOCITY="
    ;USING "####
    #.##";X
460:USING :GOTO
    10
```

magmedia magmedia

Verbatim
Datalife

Means 7 data-shielding improvements for greater durability, longer life

World's largest manufacturer of quality Digital Recording Media. Supplying the broadest range of Diskettes and Mini Diskettes, Cassettes and Mini Cassettes, Cartridges and Mini Cartridges for scientific, business and personal computer applications.

All Verbatim Media sets industry standards for long-life, error-free data storage, now with Datalife.

That's why Verbatim storage media is the choice of leading manufacturers of Digital Systems. Now it's available to you when you put your data into storage you get it back Verbatim!!

Now a comprehensive manufacturing operation is located in Melbourne, Australia. Complete laboratory and QC test facilities are available to provide customer service and testing for most Verbatim products.

Complete range available
Verbatim 8" Flexible Disks
Verbatim Cassettes
Verbatim Data Cartridges
Verbatim Optima Series Alignment Diskettes
Verbatim 5¼" Mini Disks
Verbatim Mini Cassettes
Verbatim Mini Data Cartridges
Verbatim Test Instruments

Sole Australian distributor

magmedia
Magmedia service puts the customer first

SYDNEY: 5 Apollo Place Lane Cove NSW 2066 Phone (02) 428 1100 Telex AA22703

MELBOURNE: 100 Park Street South Melbourne Phone (03) 699 9688 Telex AA35968

BRISBANE: 123 Leichhardt Street Brisbane QLD 4000 Phone (07) 229 1941 Telex AA42367

CANBERRA: 25 Lonsdale Street Braddon ACT 2601 Phone (062) 48 6751 Telex AA22703

magmedia magmedia magmedia magmedia magmedia magmedia magmedia magmedia

---

QT COMPUTER SYSTEMS (AUST.)

Microcomputers?
MACROSERVICE

283 CLARENCE ST
SYDNEY NSW 2000
TEL: 29-2402, 922-1709
ASSOCIATED WITH QT USA

QT SYSTEM+

QT Systems are designed for both businessmen and engineers in accordance with the latest IEEE standards. Among other functions, they can be used for accounting and word processing as well as a variety of scientific applications. The systems are available with MP/M or OASIS operating systems to allow multi-user, multi-tasking operations. QT also offers a full line of business and applications software, ranging from a business package to word processing.

Technical specifications: 4 MHz Z-80 CPU • Dbl-sided, dbl-den. 5¼" or 8" floppy disk controller (handles both drives simultaneously) • CP/M 2.2 included • 64K RAM, expandable per your requirements • Comes complete in single mainframe • RS232C serial port • Parallel port • Hard disk compatible • Monitor program & disk routines included on EPROM • Power-on/reset jump to monitor program • Documentation included.

MINI-SYSTEM+(½MB+)

Computer System with 5¼" Single Sided Drives (uses TEAC FD-50A Disk Drive) No Terminal.
A&T (6 slot) $3048.00
A&T (8 slot) $3073.00
A&T (12 slot) $3098.00

SBC+¾ SINGLE BOARD COMPUTER

1K RAM (which can be located at any 1K boundary) plus one each serial and parallel I/O ports • Power on jump to on board EPROM (2708 or 2716) addressable on any 1K or 2K boundary • Full 64K use of RAM in shadow mode • Programmable Baud rate selection 110–9600 • 2 or 4 MHz switch selectable • DMA capability allows MWRT signal generation on CPU board or elsewhere in system under DMA or front panel control • Two programmable timers available for use by programs.
Bare Board $66.00
A&T (incl. Monitor EPROM) $299.00*

EXPANDABLE+REV II DYNAMIC MEMORY BOARD

Runs at 4 MHz • 3242 refresh controller with delay line • Four layer PC board insures quiet operation • Supports 4×16K blocks of memory • 24 IEEE specified address lines • Optional M1 wait state allows error free operation with faster processors • Optional PHANTOM disable • Uses Z80 or on board refresh signal • Bank on/off signal selected by I/O port 40 (HEX) • DIP switch selection of data bus bits determines bank in use • LED indication of bank in use • 3 watts low power consumption.
Bare board $81.00
16K A&T $350.00
64K A&T $425.00*

SYSTEM+II (2MB+)

Computer System with 8" Dual Sided Drives (uses Y-E DATA YE-174 Disk Drive) No Terminal.
A&T (6 slot) $3883.00
A&T (8 slot) $4083.00

RAM+16

16KX8 bit static RAM • 2 or 4 MHz • Uses 2114 static RAM chip • 4K step addressable • 1K increment memory protection • Deactivates up to six 1K segments to create "holes" for other devices • DIP switch selectable wait states • PHANTOM line DIP switch • Eight bank select lines.
Bare Board $41.00
4MHz A&T $199.00*

SILENCE+ MOTHER BOARD

These mother boards are among the quietest on the market • A unique grounding matrix — with each line completely surrounded by ground shielding — eliminates need for termination and give high crosstalk rejection • They are customer proven, without crosstalk sometimes operating at 14 MHz.

	6 SLOT	8 SLOT	12 SLOT	18 SLOT
Bare Board	$31.00	$33.00	$39.00	$61.00
A&T	$61.00	$84.00	$108.00	$168.00

S–100 Sockets — Gold Plated $5.00

CLOCK/CALENDAR+ FOR APPLE II S–100 OR TRS–80

Date/Month/Year • Day of week • 24 hours time or 12 hours (a.m./p.m) selectable • Leap year • 4 interval interrupt timers • On board battery backup • Simple time and date setting • Simple software interface • Time advance protection while setting.

S–100 or APPLE
Bare Board ... $66.00
A&T $162.00

TRS–80
A&T only $167.00

SOFTWARE+

Word processing software • System utilities • Games • CP/M user group diskettes — $10.00 each • Pascal, Forth, Cobol, Fortran, Basic and most other compilers and interpreters are available • Account receivable, payable, general ledger, stock control application software packages are our specialty • Call for details • We provide unequalled local software support for CP/M systems • Custom programming can be arranged on fixed price or hourly basis.

PRICES DO NOT INCLUDE SALES TAX OR DELIVERY, AND ARE SUBJECT TO CHANGE WITHOUT NOTICE. SPECIAL OFFERS ARE MARKED*

PET talk — memory test

K. Townsend

MEMORY TEST is a simple program for PET owners, or those with other micros that support sound boxes. The game is a version of the 'Simon' toy in that you have to remember an increasing sequence of numbers and their associated tones.

All the instructions are included in the program and the characters within square brackets are to the usual CT standards. Connections to a soundbox are from the N and M pins on the user port. A simple amplifier will suffice.

Program listing

```
1 REM**MEMORY TEST
4 CLR
5 PRINT" [CLS ]MEMORY TEST"
6 S1=59464:S2=59466:S3=59467
8 PRINT"    ====== ===="
10 PRINT"THE IDEA OF THIS GAME IS TO
   REPRODUCE"
20 PRINT"THE SERIES OF NUMBERS I WILL
   PRINT FOR"
30 PRINT"YOU."
40 PRINT"IF YOU MAKE A MISTAKE PRESS
   'HOME' & TRY"
45 PRINT"AGAIN, OR PRESS 'DEL' TO DELETE
   LAST GO "
50 PRINT"PRESS 'E' TO END."
60 PRINT"DO YOU REQUIRE SOUND? (Y/N) ";
61 GET A$
62 NU=RND(TI):REM**RANDOMISE
63 IF A$=" "THEN 61
70 IF A$="N" THEN POKE S3,0:GOTO 77
75 IF A$="Y" THEN POKE S3,16:GOTO 77
76 GOTO 61
77 PRINT A$
79 INPUT"RATE OF CHANGE OF SEQUENCE
   LENGTH",R
80 INPUT"MAXIMUM SEQUENCE LENGTH?",S
83 IF S>80 THEN S=R-1:REM ** 80 IS MAX FOR
   8K PET
85 IF S<R THEN PRINT"ERROR, SEQUENCE
   LENGTH(";R,"TO 80)";:INPUT S:GOTO 83
94 PRINT"GOOD LUCK!":FOR Q=1 TO 700:NEXT
95 REM**PICK SEQUENCE & STORE
99 DIM N(S+2),M(S+2)
100 FOR A=1 TO S
150 N(A)=INT(10*RND(TI))
200 NEXT
300 G=0
350 REM**MAIN PRINTING ROUTINE
400 G=G+R
410 IF G>S THEN G=S
450 PRINT" [CLS ] [8 CD ]";
500 FOR A=1 TO G
530 POKE S2,15:POKE S1,150-N(A)*10
550 PRINT N(A)" ",
555 FOR X=1 TO 100:NEXT:POKE S1,0
560 IF A/10=INT(A/10)THEN PRINT" ";
600 NEXT
650 PRINT" [HOM ]YOU HAVE ";INT(G/2);"
    SECONDS TO MEMORISE THE SEQUENCE";
651 PRINT"      ";G;"NUMBERS"
700 FOR Q=1 TO 450*G:NEXT
730 REM**YOUR REPLY
740 POKE S1,70:FOR P=1 TO 100:NEXT:POKE S1,0
750 PRINT" [CLS ]O.K. NOW RETYPE THE
    SEQUENCE"
753 FOR K=1 TO 10:GET W$:NEXT
755 REM**SOAK UP EXTRA KEY PRESSES
780 PRINT" [HOM ] [8 CD ]";:FOR C=1 TO G:
    PRINT" [↑$ ] ";:IF C/10=INT(C/10) THEN
    PRINT" ";
790 NEXT
795 PRINT" [HOM ] [8 CD ]";
800 FOR A=1 TO G
810 FOR U=1 TO 100:NEXT
830 POKE S1,0
850 GET A$:IF A$=" "THEN 850
855 B=VAL(A$)
860 IF A$=" [HOM ]"THEN PRINT" [CLS ]TRY
    AGAIN":POKE S1,0:FOR K=1 TO 1000:NEXT:
    GOTO 750
862 POKE S2,15:POKE S1,150-10*B
863 IF A<=2 THEN GOTO 868
865 IF A$=CHR$(20)THEN A=A-1:PRINT" [3 CL ]
    [↑$ ] [2 CL ]";
867 IF A$=CHR$(20)AND(A-1)/10=INT
    ((A- 1)/10) THEN PRINT" [CU ]";
868 IF A$=CHR$(20)THEN 810
869 IF A$="E" THEN POKE 59467,0:END
873 PRINT B;" ";
875 REM**PRINT IN ROWS OF TEN
876 IF A=0 THEN 880
877 IF A/10=INT(A/10)THEN PRINT" [CD ]";
880 M(A)=B
900 NEXT A
910 POKE S1,0
950 REM**CHECK FOR ERRORS
999 ER=0
1000 FOR A=1 TO G
1010 IF N(A)<>M(A) THEN ER=ER+1
1050 NEXT
1100 IF ER>0 THEN GOTO 1500
1130 IF S>G THEN GOTO 1150
1140 GOTO 5000
1145 REM**CORRECT REPLY
1150 PRINT" [CLS ]CORRECT      TRY A LONGER
     SEQUENCE"
1155 REM**TONE FOR CORRECT REPLY
1156 POKE S2,15:POKE S1,50:FOR Z=1 TO 20:POKE
     S1,50
1160 FOR X=1 TO 80:NEXT:POKE S1,100:NEXT:
     POKE S1,0:GOTO 400
1460 REM**INCORRECT REPLY
1500 PRINT" [CLS ]WRONG, YOU MADE";ER;
     "MISTAKES, TRY AGAIN"
1520 REM**TONE FOR INCORRECT REPLY
1530 POKE S2,15:POKE S1,200:FOR Q=1 TO 12:
     POKE 59464,230
1550 FOR U=1 TO 35:NEXT:POKE 59464,180:NEXT:
     G=G-R:GOTO 400
2000 T=TI:IF TI=T+60*G THEN NEXT
4200 REM**TOTAL SEQUENCE
5000 PRINT" [CLS ] [7 CD ]      FANTASTIC!"
5010 PRINT"YOU MADE YOUR SEQUENCE OF";
     INT(S);"NUMBERS"
5050 FOR H=1 TO 7
5060 FOR J=200 TO 10 STEP-10
5080 POKE S1,J/2
5100 NEXT:NEXT
5150 REM**POKE 59467,0 TO REACTIVATE
     CASSETTE
5200 POKE 59464,0
5500 PRINT"ANOTHER GAME?";
5510 GET A$:IF A$=" "THEN 5510
5515 PRINT A$
5520 IF A$="Y" THEN 1
5530 IF A$="N" THEN POKE 59467,0:END
5555 GOTO 5500
63999 END
```

In the world of personal computers there is just one that is known as the best: the PET

NOW 16K RAM AT 8K PRICE $999

The Commodore PET has become the standard for the Personal Computer Industry.

The Pet is completely integrated, with the processor, memory, keyboard and visual display unit contained within a robust housing, allowing easy transportation with no interconnecting cables necessary. In order to retrieve and save your data and programs, a storage device is used which operates like a cassette recorder, with your information recorded reliably on standard cassettes. The PET has 16k bytes of RAM. Optional equipment permits expansion to 32k. Also, it has 14k bytes of ROM.

The Pet communicates in BASIC— the easiest computer language. Easy to learn and easy to use, BASIC has now become the standard for personal computers, with literally thousands of programmes available. The PET is also programmable in machine language, allowing more efficient use of the system.

The full-size keyboard is capable of producing letters, numbers and graphic symbols. Upper and lower case is standard. Characters appear on the screen in a pleasant green colour designed to reduce eye fatigue and may be displayed in normal or reverse print.

PET's IEEE-488 Bus- just like H.P.'s mini and full size computers — permits direct connection to over 200 pieces of compatible equipment such as counters, timers, spectrum analysers, digital voltmeters and printer plotters from H.P., Philips, Fluke, Textronix and others.

The full range of Commodore Disk Drives and Printers are plug-compatible with the PET and a comprehensive range of cassette and disk based programmes are available through the extensive network of Commodore Dealers.

APPLICATIONS

The Commodore PET is a creature of many faces. Its applications are limited only by the user's imagination.

The future of the PET is virtually unlimited; its present capabilities are already many and impressive. As a personal computer, the PET can teach languages and mathematics; play games; create graphic designs; store meal recipes and change number of portions; maintain budgets, personal records and checkbooks; operate appliances and temperature controls.

As a management tool, it delivers the information the executive needs, in the form he can use, and available to him alone. Trend analyses charts and graphs can be almost instantly available.

The professional may use the PET for maintaining appointment schedules, recording income and expenditures and filing all the specialized information and forms he may need to make his work more efficient — from medical records for a doctor to income tax computations for an accountant.

The engineer, mathematician, physicist, has a tool far superior to the very best programmable calculators yet developed... at a cost that is comparable...and with almost infinitely greater versatility.

And the businessman has a computer that can maintain inventories, keep payroll records, operate accounts payable and receivables, issue cheques and handle correspondence.

Commodore PET 4016 Computer Technical Specifications.

Computer/Memory

Read/Write Memory (RAM) 16K bytes available to the user.
Read Only Memory (ROM) 14K bytes in total, divided into:
8K BASIC interpreter available immediately you turn on your PET,
5K Operating System
1K Test Routine
The 6502 micro-processor chip makes the PET one of the fastest and most flexible BASIC systems. Significant features of Commodore BASIC are:

- 960 simple variables
- 960 integers
- 960 string variables
- 960 multi-dimensional array fields for the above 3 types of variables
- Up to 80 characters per program line with several statements per line
- Upper/Lower case characters and graphics capability
- Built in clock
- 9-digit floating point binary arithmetic
- True random number generator
- Supports multiple languages; machine language accessibility

Keyboard

74-Key professional keyboard.
Separate calculator/numeric pad.
Upper-case alphabetical characters with shift key to give 64 graphics characters.
Can be set for lower case and shifted upper case characters.

Screen

40 characters wide by 25 lines (1000 characters in 8 × 8 dot matrix).
23 cm screen phosphor screen.
Brightness control.
64 ASCII plus 64 graphics characters.
Blinking cursor with full cursor control, including programmable control.

Screen editing capabilities

Full cursor control (up, down, left, right).
Character insert and delete.
Reverse character field.
Overstriking.
Return key sends the entire line to the CPU regardless of cursor position.

Input/Output

8 bit parallel input/output port.
IEEE-488 Bus (HP-IB and IEC Bus) allows up to 12 other peripherals to be connected.
Two cassette ports.
Video signals for additional displays.
Serial output port.

Technical Data

Dimensions:Height 355 mm (14″), Width 419 mm (16.5″), Depth 185 mm (18.5″). Shipping Weight 20.9 kg (46 lbs).
Power requirements 240V ± 10%. Frequency 50 Hz. Power 100 Watts.

Commodore BASIC

APPEND	GOSUB..RETURN	STOP	SPC
BACKUP	IF..THEN	SYS	LEFT$
CLOSE	INPUT	VERIFY	RIGHT$
CLR	INPUT *	WAIT	MID$
CMD	LET		CHR$
COLLECT	LIST	SGN	ASC
CONCAT	LOAD	INT	LEN
CONT	NEW	ABS	VAL
COPY	ON..GOSUB	SQR	STR$
DATA	OPEN	SIN	TI
	POKE	COS	TI$
DEF/FN	PRWT	TAN	ST
DIM	READ	ATN	DS
DIRECTORY	RECORD	LOG	DS$
DLOAD	REM	EXP	+
DOPEN	RENAME	AND	—
DSAVE	RESTORE	OR	*
END	RUN	NOT	/
FOR/NEXT	SAVE	TAB	↑
GET	SCRATCH	POS	π

commodore microcomputers

For details of your local dealer send to: Commodore Information Centre, Box 336, Artarmon, NSW 2064. Australia. Phone (02) 437 6296

Mlvl 469

WE ARE MOVING FROM SEVEN HILLS TO . . .

Calculator & Computer

DISTRIBUTORS

SPECIALS

- APF5602 40 FUNCTION SCHOOL CALCULATORS — OUT THEY GO — $12 ea. Excl. Tax

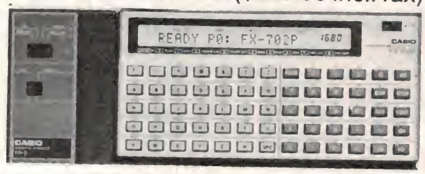
TEXAS INSTRUMENTS

- TI59 AND PC100C ONLY $440 Ex. Tax $499 Incl. Tax
- SPEAK & SPELL $76
- SPEAK & MATHS $79
- SPEAK & READ $89
  EXTRA MODULES $21

ALL POST FREE
BANKCARD WELCOME

NEW CASIO FX 702P POCKET COMPUTER

ONLY $233.70 ex. Tax ($259.95 incl. Tax)



UNBEATABLE FEATURES

- 10 TIMES FASTER THAN OTHER MODELS
- 1680 STEPS/226 MEMORIES.
- PROGRAMMABLE IN BASIC.
- 55 KEY BOARD FUNCTIONS.
- BRILLIANT L.C.D. DOT MATRIX DISPLAY.
- PROGRAM LIBRARY — 73 PROGRAMS, ENGINEERING, STATISTICS, MATHEMATICS, BUSINESS, GAMES, ETC.

OPTIONAL PERIPHERALS

- FA-2 ADAPTOR FOR CASSETTE.
- FP-10 PRINTER.

NEW SHOWROOMS

SUITE 2, 138 OLD TOWN CENTRE PLAZA, BANKSTOWN, NSW 2200
(RIGHT ABOVE RAILWAY STATION)

GRAND OPENING MONDAY NOVEMBER 16th.

CALL IN AND SEE OUR BIG RANGE
(WE WILL BE OPEN THURSDAY TILL 8.00 PM AND SATURDAY 9.00 TO 12.00 NOON.)

- HOME COMPUTERS — SINCLAIR ZX81, COMMODORE VIC AND MANY MORE. BUSINESS COMPUTERS — SORD, DIABLO, INTERTEC ETC. WE SPECIALISE IN CUSTOM SOFTWARE.
- PROGRAMMABLE CALCULATORS — FULL RANGE OF HEWLETT-PACKARD TEXAS AND CASIO.
- CALCULATORS — FOR BUSINESS, EDUCATIONAL, SCIENTIFIC, CLOCK, NOVELTY ETC., ETC.

UNTIL THURSDAY, 12th NOVEMBER WE WILL STILL BE AT:
3 ROWLEY ST, SEVEN HILLS 2147
PHONE (02) 624 8849 OR 624 8400

COMMUNICATE

with the NEW Sendata 700 Series Acoustic Couplers

These low cost models from Electromed are compatible with Telecom modems and Telecom now approve the use of the Acoustic Coupler at each end of the data link.

The new 700 Series Acoustic Modems are modular in design and simple to operate. "Answer Originate" and "Originate Only" models are available.

These modems operate at 300 BPS to 1200 BPS and suit most RS232 compatible computers and terminals. The new 700 Series modems communicate with other local or distant computers and are powered directly from the peripheral or via a 9v plug rack.

Available now. Call in and see a full demonstration at

The Logic Shop

Computer Systems.

212 High Street, Prahran VIC 3181. (03) 51 1950, 529 2771.
91 Regent Street, Chippendale NSW 2008. (02) 699 4910, 699 4919.
454 William Street, Perth WA 6000. (09) 328 7345.
Shop 16 Civic Arcade Adelaide Street, Brisbane QLD 4000. (07) 31 2330.

LSI-015

Yes! With every 16K Sorcerer computer, we now include at no extra charge, an additional 16K of RAM! Here's your chance to buy the superb Sorcerer, and save money at the same time.

Plus these other winning features:

- Built-in serial and parallel ports — standard!
- 2 cassette control ports — both with motor control!
- Powerful graphics capabilities.
- Expandable to 48K on board.
- Uniquely versatile ROMPACS™ — instant change to dedicated processor, and back again!
- Built-in 4K ROM resident monitor.
- Economic disk storage now available (optional) with Exidy's new FDS — floppy disk subsystem (does not need expansion interface).

All this for only $1395
including 32K memory and standard BASIC ROMPAC™
Cat. X-3002

ROMPACS™
Give the Sorcerer its incredible versatility

One moment it's a word processor. Then it's a production controller. Or a standard computer running a program. All you do is plug in the Rompac™ The Sorcerer does the rest!

Word Processor Pac™ — $279
Not only more powerful than most other systems. it's far cheaper! It features auto text wrap-around, auto checking of drastic commqnds, a search function, auto commands & macro programming etc etc.(X-3085).

EPROM PAC™ — $75.00
Designed for users who want to use the Sorcerer for a dedicated job & can program their own EPROMs to do it. Up to 16K of ROM available. (X-3095).

Development Pac™ — $139.50
A powerful dedicated development tool: contains a debug, text editor, linking loader, assembler & I/O routines. Complete with 90p manual. (X- 3090).

Standard BASIC
(Supplied with Sorcerer computer in basic price - not available as a separate item).

UTILITY SOFTWARE ON CASSETTE

Z-80 DISASSEMBLER — $17.95
This program 'disassembles' Z-80 machine language programs i.e. it translates them back into easier to follow assembly language. It is a BASIC program, but may be used to examine any machine language program in the Sorcerer's memory. X-3622

DEBUG — $17.95
Designed to make it much easier to troubleshoot Sorcerer machine language programs. Lets you run programs one instruction at a time, examine contents of processor registers & insert breakpoints into the program wherever needed. X-3624

DUMB TERMINAL — $9.95 X- 3637
Allows your Sorcerer to act as a 'dumb' communications terminal for communication with a larger computer or with other terminals via the RS-232C serial port. Allows both duplex & half duplex operation

DISK UTILITIES FOR FDS & MICROPOLIS

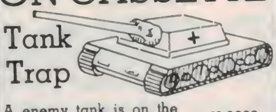
EXIDY CP/M with EXBASIC — $445 X-3710
Supported by Exidy CP/M, EX-BASIC is an extended disk version of Microsoft™ BASIC 80. Complete with comprehensive documentction.

DSKCITOH/PPRINT (Hard Sector) — $99 X-3725
Disk driver & proportional printing driver for the Sorcerer Word Processor. Check these features ability to save & load word processor files on disk, perform proportional spaced printing (Needs CP/M)

MICROSOFT EXT. DISK BASIC FOR FDS — $350 X-3712
The most extensive version of BASIC available for Z-80 based computers. Features full line editing, all normal disk facilities & commands, & much, more!

SORCERER GAMES SOFTWARE ON CASSETTE

Tank Trap — X-3628 — $14.95



A enemy tank is on the rampage. Your job is to build a wall around it - without getting run over. Fascinating!

Martian Invaders — $17.95 X-3626

Very similar to 'Space Invaders'. A very challenging game, requiring skill & a fast mind.

*** Voodoo Castle** HALF PRICE! — $6.25 X-3636
An action packed adventure in the Voodoo castle. Hours of fun! But beware of the Voodoo Man

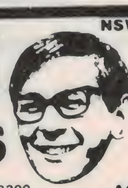
*** Wilderness** — $12.50 X-3639
Here you trudge through the uncharted wilderness fighting foul monsters of many types. Great fun!

***The Count** — $12.50 X-3638
One of the most challenging games ever written! You awaken in a bed in Transylvania. You don't know why you're there but you'd better solve the puzzle before it's to late!

Magic Maze — $14.95 X-3620
Ten levels of play. You wander through a maze trying to stay on the right path and avoid pitfalls. Fantastic!

* LIMITED STOCKS

DICK SMITH Electronics



NSW	145 Parramatta Rd	AUBURN	648 0558
	613 Princes Hwy	BLAKEHURST	546 7744
	818 George St	BROADWAY	211 3777
	531 Pittwater Rd	BROOKVALE	93 0441
	147 Hume Hwy	CHULLORA	642 8922
	162 Pacific Hwy	GORE HILL	439 5311
	396 Lane Cove Rd	NORTH RYDE	888 3200
	30 Grose St	PARRAMATTA	683 1133
	125 York St	SYDNEY	290 3377
	173 Maitland Rd	TIGHES HILL	61 1896
	263 Keira St	WOLLONGONG	28 3800
ACT	96 Gladstone St	FYSHWICK	80 4944
QLD	166 Logan Rd	BURANDA	391 6233
	842 Gympie Rd	CHERMSIDE	59 6255
SA	60 Wright St	ADELAIDE	212 1962
VIC	399 Lonsdale St	MELBOURNE	67 9834
	260 Sydney Rd	COBURG	383 4455
	656 Bridge Rd	RICHMOND	428 1614
	Cnr Dandenong & Springvale Rds	SPRINGVALE	547 0522
WA	Cnr Wharf St & Albany Hwy	CANNINGTON	451 8666
	414 William St	PERTH	328 6944

Mail Order Centre: PO Box 321, North Ryde 2113. Phone (02) 888 3200

ADVANCED BASIC

Part 4

Interpreters, compilers and assemblers

Phil Cohen

Following its series on Back Door into BASIC, ETI has begun a series on Advanced BASIC for those who want to expand their knowledge further. Phil Cohen has already examined 'Sorting', 'Chaining' and 'Top-down programming' in earlier parts of the series, and this month his subject is 'Interpreters, compilers and assemblers'.

A FEW MONTHS ago I attended a meeting of an amateur computer society (which shall remain nameless) and heard the speaker (who shall also remain nameless) asked the question, "What's the difference between an interpreter and a compiler?". He thought for a few moments and then said, "Well, a compiler is non-interactive, isn't it?" (i.e: you can't enter data while the program is running).

This is of course totally wrong. The reason *why* it's wrong is, however, interesting. Compilers just aren't found in home systems yet. The reason for this is that they tend to need more RAM and are more difficult to design than interpreters. Thus they are usually found in mainframe systems only. Why, if they're so much trouble, should professional programmers use them? The answer is that they are extremely powerful — their advantages are well worth the extra RAM.

In order to describe what exactly a compiler (and, while we're at it, an assembler) is, we have to define a few terms:

SOURCE CODE: The program in BASIC (or whatever) as it is typed in, spaces and all.

OP CODES: Or 'operator codes' — a set of numbers (usually one byte each) which represent BASIC keywords. In the Commodore PET, the source code is translated into op codes as it is fed in (try putting graphics characters in a REM statement).

MACHINE CODE: Well, anyone who started reading this article should know what this is, but just in case — it's a set of numbers, each of which represents an instruction to the processor itself.

ASSEMBLY CODE: A set of mnemonics (usually three or four characters each) which are easier to remember than machine code, but mean the same — there is a 'one-to-one correspondence' between machine code and assembly code.

INTERMEDIATE CODE: Or, in the case of PASCAL, 'P-code'. This is a set of instructions to an imaginary processor. This is more useful than it sounds, as will be explained later.

INTERPRETER: A program which pretends to be a processor which will accept source code or op codes as instructions.

ASSEMBLER: A program which translates assembly code into machine code.

COMPILER: A program which translates source code into machine code. Some compilers translate source code into intermediate code, which is then run on an interpreter which pretends to be the intermediate code's processor. This is a compromise between a compiler and an interpreter.

EDITOR: A program which allows source code or assembly code to be input, changed, listed and generally messed about.

ASSEMBLER/EDITOR: A package containing one of each.

Assemblers

What is required of an assembler? While on the one hand some very primitive ones just take in one assembly code mnemonic at a time and output one (or more) bytes of machine code, most assemblers do a lot more. Let's take the example of the following program segment:

```
ADDRESS
1         LDA 8
3         DEC
4         JNZ 3
```

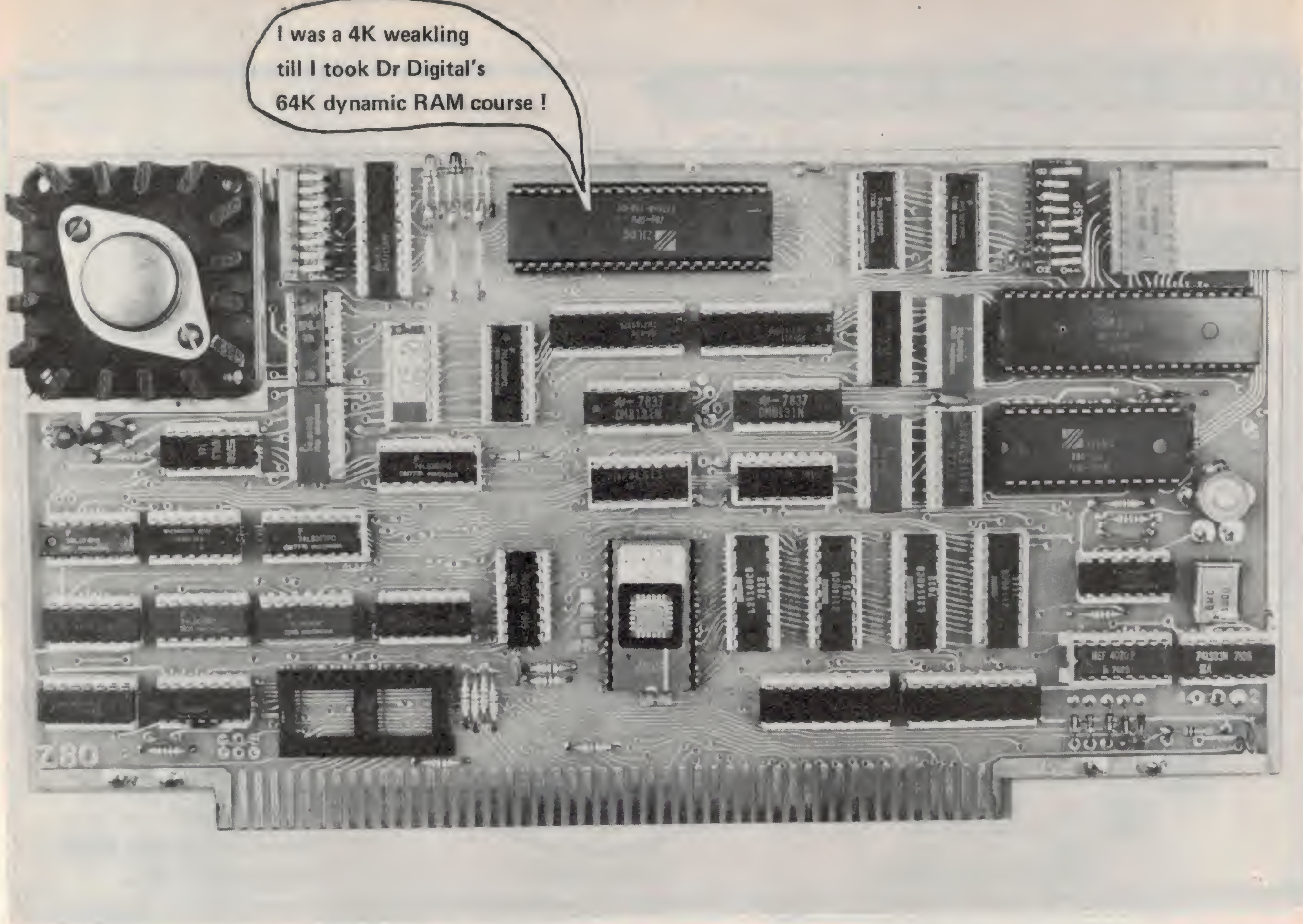
The address is the position in RAM of the first byte of each instruction. LDA causes the next byte of code to be loaded into the accumulator. As the assembler knows that this is a two-byte instruction, it will look for a parameter for LDA — in this case 8. DEC decrements the accumulator. JNZ jumps to byte 3 if the accumulator is not zero. Fine. What if we want to change it to:

```
IN 1
INC
JNZ
DEC
```

In other words, input the accumulator value from port 1, add 1 to it, then loop as before.

How do we know the parameter to use for JNZ? — in a long program we won't know the address of DEC until it is assembled. We can get the assembler to save us the trouble of sorting this out by hand by adding a 'label' facility:

```
    IN 1
    INC
```




```
A: DEC
   JNZ A
```

The assembler will remember the address of point A and use it as the parameter of JNZ.

What if we want to write:

```
   IN 1
   INC
A: JNZ B
   DEC
   JMP A
B: RTS
```

One of the labels points further down the program. At point A the assembler won't know what the address of point B is. A decent assembler will solve this by using a 'multi-pass' technique. That is, it will go through the program more than once. The first time it will find the addresses of all the labels and the second time it will actually produce the machine code. Between passes it will store the label values in a 'symbol table', which will hold the label names and values. This table is very useful for debugging and may be printed out.

Another facility is the use of variable names. These will refer to areas of RAM which can be referred to by name rather than by location. These too will go into the symbol table.

Other facilities may include comment statements (like REMs) and other debugging aids.

Compilers

In many ways compilers are very much like assemblers — the major difference being the source code. Compilers also produce symbol tables.

Trying to design a compiler is probably the best way to get to know how they work. There are a lot of problems which only appear while actually trying to design one. In an earlier article I said that entire books had been written about sorting algorithms. Well, *libraries* have been written about compilers!

The power of a compiler, as opposed to an interpreter, is due to three things:

a) The compiler checks *every* line of a program as it compiles it — there's no chance of a syntax error appearing while the program is running.

b) The machine code output runs about ten times faster than an interpreter.

c) It is easier to provide a 'structure' to the language — some compiled languages (e.g: ALGOL 68) do not need GOTO-like statements because the language is constructed to make it possible to do almost anything in a loop structure. For example, the BASIC statements:

```
10 FOR I = 1 TO 10
20 IF A(I) = B THEN 40
30 NEXT I
```

could be done in an ALGOL-like language simply as:

```
10 FOR I TO 10 WHILE A(I) <> B DO
20 NEXT I
```

I personally think that the sooner small compilers become available the better, especially for highly structured languages such as PASCAL or PL/I. Writing in BASIC implies the use of GOTO statements; some people would hold that this leads inevitably to 'bad habits' in program writing. Certainly, having programmed in both ALGOL and BASIC, I very much prefer the former. The recent rises in personal computing power *should* mean that structured-language compilers will soon be available — I only hope that BASIC is not too firmly embedded in the market to be removed quickly and painlessly.

The following program could form part of an interpreter or compiler. Basically what it does is to sort out bracketed statements in terms of precedence of execution. The program is 're-entrant'. This means that it uses *itself* as a subroutine. Say we have a program segment to strip leading spaces off a string. One way to structure it would be:

```
10  REM REMOVE SPACES
20  A$ = RIGHT$ (A$, LEN(A$) − 1)
30  IF LEFT$(A$, 1) = " " THEN ▶
```

LET THE

AUSTRALIAN SOURCE

BRING MAINFRAME POWER INTO YOUR HOME OR OFFICE

WE ARE PROUD TO ANNOUNCE THE LAUNCHING OF AUSTRALIA'S FIRST MICROCOMPUTER INFORMATION UTILITY

The AUSTRALIAN SOURCE is Australia's first microcomputer information utility, aimed at giving the average microcomputer user access to the computer data banks and also massive storage space previously only available to large Mainframe installations. The era of home computers has now officially begun in Australia, now that the AUSTRALIAN SOURCE is here; as now, any small businessman or student can have on his desk for an extremely small cost, a system that has the level of storage power and access to data banks for which only a few years ago, government departments and large private users were paying millions of dollars.

The AUSTRALIAN SOURCE can be accessed through a number of 'approved' personal computers, and terminals, by use of an accoustic coupler or modem.

Users will receive a number of benefits which will include:

INFORMATION SERVICES

Members will have access to a number of information sources which will include the latest news, sports results, financial reports, and farm information.

NATIONWIDE ELECTRONIC MAIL

Members will be able, also, to communicate nationwide with other AUSTRALIAN SOURCE members through our electronic mail system.

THE AUSTRALIAN SOURCE RECOMMENDS 3M DISKETTES

SOFTWARE BANK

Users will have access to a myriad of computer programs that will include entertainment, educational aids, programming and diagnostic tools, and financial applications.

MAINFRAME POWER

Users will have the capability to make use of the Mainframe's huge storage capacity by using any of our large programs, or storing your large programs on our system.

SHOP AT HOME

You can take advantage of our 'shopping by computer' system to get the best prices on a number of popular consumer items.

EXTREMELY EASY TO USE

You do not have to be a computer programmer to make use of the AUSTRALIAN SOURCE. All of the instructions are in everyday English, so that even the younger members of your family will be able to operate the system.

LOW COST

While services like these used to cost tens of thousands of dollars to the government departments and large corporations who used them, they are now available to you for less than the cost of a packet of cigarettes a day for the 'average' user.

You can join the AUSTRALIAN SOURCE by paying a one-time joining fee (normally \$100) and a small hourly user charge (normally \$10 an hour 8 a.m. – 6 p.m. and \$4.50 an hour 6 p.m. – 8 a.m.).

SPECIAL CHARTER MEMBER OFFER

Joining before 1st February, 1982, qualifies for CHARTER MEMBER status; substantial discount off the normal \$100 joining fee; and a lifetime percentage discount off the normal hourly user charge.

TO FIND OUT MORE ABOUT THESE EXCITING SERVICES OF THE AUSTRALIAN SOURCE AND HOW WE CAN TURN YOUR OWN MICROCOMPUTER INTO A MAIN–FRAME, PLEASE COMPLETE THE COUPON, BELOW:

INFORMATION REQUEST

Please send me your free information package on the services available from the AUSTRALIAN SOURCE and how I can join.

☐ I have a computer

brand.............................. model............

☐ please send me information on low cost equipment packages I can use to take advantage of the AUSTRALIAN SOURCE'S SERVICES.

NAME..

ADDRESS..

CITY..

STATE...................... POSTCODE..........

PHONE...

Mail to:
THE AUSTRALIAN SOURCE
(A Division of Tergo Quen Pty., Ltd.)
364 Latrobe St.
Melbourne, Victoria 3000
(03) 329–7998

GOSUB 10
40 RETURN

Line 30 causes the routine to be re-entered unless there are no spaces left. While the above task *could* be done using a simple loop, the task of analysing a bracketed expression is such that intermediate results have to be stored in a particular order. The easiest way of doing this is to use a re-entrancy with a stack structure to hold the intermediate results. As the RETURN address of each GOSUB in a program is held in a stack also, there will be a correspondence between the two. The easiest way to understand this is to follow the program's action.

Given an input of, say, A(B)C, it will output the lowest priority part of the expression first and remove it from the input string. It will then re-enter with the remaining string:

input: A(B)C
output: C A B

input: A((B)C(D(E)))
output: A C B D E

First, the main program:

100 DIM S$(30)

S$ is the stack.

110 SB = 0 : SE = 30

SB marks the top of the stack, SE is the maximum stack height.

120 INPUT I$

I$ is the expression to be analysed.

130 GOSUB 1000 : REM ANALYSE
140 GOTO 120

Now for the analysis routine.

1000 REM ANALYSE
1010 IF I$ = " " THEN RETURN

checks for null input string — finished.

1030 J = 0

J is the current bracket depth.

1035 I = LEN(I$) + 1
1040 I = I − 1

This is part of a loop in which I goes from LEN(I$) to 1. This form (initialising I to the value above its starting value) allows the decrement of I to be at the start of the loop.

1045 IF I ‹ 1 THEN 1080

end of loop check.

1047 IF J ‹ 0 THEN STOP

negative J means too many "("s — an error.

1050 T$ = MID$ (I$, I, 1)

T$ is a temporary store to speed the program up — saves working out MID$() every time.

1055 IF T$ = ")" THEN J = J + 1 : GOTO 1040
1056 IF T$ = "(" THEN J = J − 1 : GOTO 1040

adjust J to be equal to the bracket depth. If T$ gets past 1055 and 1056 it must be a character for output — but only if it's outside the outer set of brackets.

1057 IF J‹›0 THEN 1040

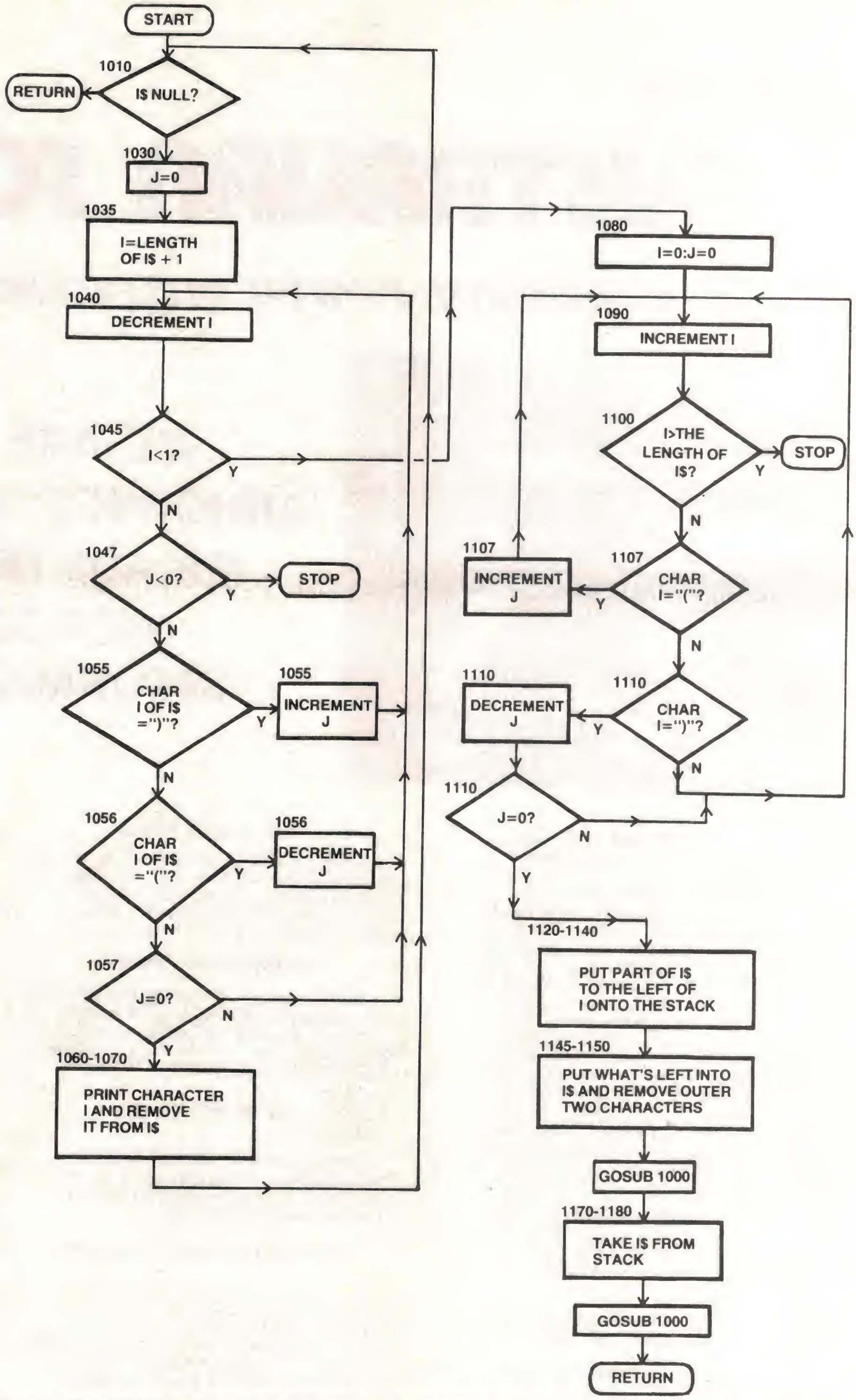


Figure 1. **Flowchart for a 'synthetic analyser' — a program to deal with bracketed expressions for a compiler. The input string is I$.**

Okay, T$ must be valid output if it gets to here.

1060 PRINT "−"; T$; "−"

The "−"s are to show T$ clearly even if it's a space. Now we have to remove T$ from I$:

1061 IF LEN(I$)=1 THEN I$=" ":GOTO 1070
1062 IF I=1 THEN I$=RIGHT$ (I$,LEN(I$)−1):GOTO 1070
1063 IF I=LEN(I$) THEN I$=LEFT$ (I$,LEN(I$)−1): GOTO 1070
1065 I$ = LEFT$(I$, I−1) + RIGHT$(I$ LEN(I$) − 1)

Lines 1061, 1062 and 1063 are necessary because some forms of BASIC (including, unfortunately, the one I'm working in) won't accept LEFT$(I$,0) or RIGHT$(I$,0).

1070 GOTO 1000

deals with the next character. Line 1045

(the end of the loop) points to:

1080 I = 0 : J = 0

I again points to a specific character in the string and J is again the bracket depth. This part of the program splits the string into a complete bracket pair and another part. It re-enters with both of them.

1090 I = I + 1

1100 IF I > LEN(I$) THEN STOP

Line 1100 stops the program if a string which got to line 1080 didn't have a bracket pair in it.

1105 T$ = MID$(I$, I, 1)

1107 IF T$ = "(" THEN J = J + 1 : GOTO 1090

1110 IF T$ = ")" THEN J = J − 1 : IF J=0 THEN 1120

if I points to the end of a bracketed expression, go to line 1120, otherwise:

1115 GOTO 1090

to try the next character.

1120 SB = SB + 1

1130 IF SB > SE THEN STOP

increments the stack pointer and checks for stack overflow.

1135 IF I = LEN(I$) THEN S$(SB) = " " : GOTO 1145

1140 S$ (SB) = RIGHT$(I$, LEN(I$) − I)

1145 I$ = LEFT$(I$, I)

splits I$ at character I. The value of I marks the end of a complete bracket pair. Line 1135 serves the same purpose as line 1061 to 1063.

1150 I$ = MID$(I$, 2, LEN(I$) − 2)

removes the outer two characters (which should be "(" and ")").

1160 GOSUB 1000

re-enters. This will (eventually) reduce I$ to " ".

1170 I$ = S$(SB)

1180 SB = SB − 1

takes the rest of I$ back off the stack.

1190 GOSUB 1000

re-enters with it.

1200 RETURN

finished. Jumps back to wherever it was called from, be it within the subroutine or (when finished) from line 140. ●

(This article concludes Phil Cohen's 'Advanced Basic' series.)

FIRST CONSIGNMENT SOLD OUT IN 2½ DAYS! STRICTLY LIMITED STOCKS

Electronics Australia/ DICK SMITH SUPER 80 Computer Kit

from $289.50

STOCKS VERY LIMITED
Because of huge demand, most stores have sold out of this kit. We're making them as fast as we can — preference will be given to orders with deposits.
HURRY — ORDER YOURS NOW!

Cat. K-3600

Inbuilt power supply: just add a transformer

Enormous 16K RAM on board lets you load large programs (pcb allows for up to 48K)

Inbuilt cassette interface: 300 baud Kansas City Standard allows you to load your BASIC interpreter from any cassette player. You can also swap programs

Full size professional 60 key keyboard allows ease of operation

If, like me, you are fed up with purchasing built-up products, here's your chance! Just imagine being able to tell your friends that you ACTUALLY BUILT your own full size computer — they probably won't believe you!

Very advanced design - but works with any TV set!

The 'Super 80' offers a specification that we believe just cannot be bettered at the price. It uses the popular Z80 Microprocessor IC, a professional keyboard and has a direct RF output so that you can use the computer with any TV set (you don't need to purchase a special video monitor).

Easy to build.

Even though we would not recommend this kit to the raw beginner, this kit is extremely straightforward and easy to build. Any person who can use a small soldering iron and can solder neatly should have no difficulty in construction. This is because of the unique double side board design which means there is virtually no other wiring. The board is covered with professional 'solder mask'; this makes soldering much easier without the problems of bridges, etc. Once the components are soldered onto the board in their marked positions over 98% of the construction is completed. Even if you cannot get the completed kit to work, we have a special "Sorry Dick it doesn't work" repair service to assist you.

Lower price, higher specification - how is it done?

Most computers sold in Australia are manufactured in the U.S.A. where extremely high labour rates prevail - and you pay dearly for this on built up units. With this computer kit, you provide the labour and therefore save a fortune. And remember, this computer does not have a small toy-like calculator keyboard but a full size professional typewriter keyboard.

THE ABOVE PHOTO SHOWS THE BASIC BOARD WITH THE FOLLOWING

Advanced programming capability.

One of the most popular computers in the world (the Tandy TRS80 Level 1) only has 4K of BASIC. The BASIC we have with this unit is a large 9K. When you consider that our popular Sorcerer computer (over 2,000 sold) only has an 8K BASIC and sells for over $1,000, it is obvious that by building yourself, you are saving real money.

Electronics Australia/ Dick Smith design.

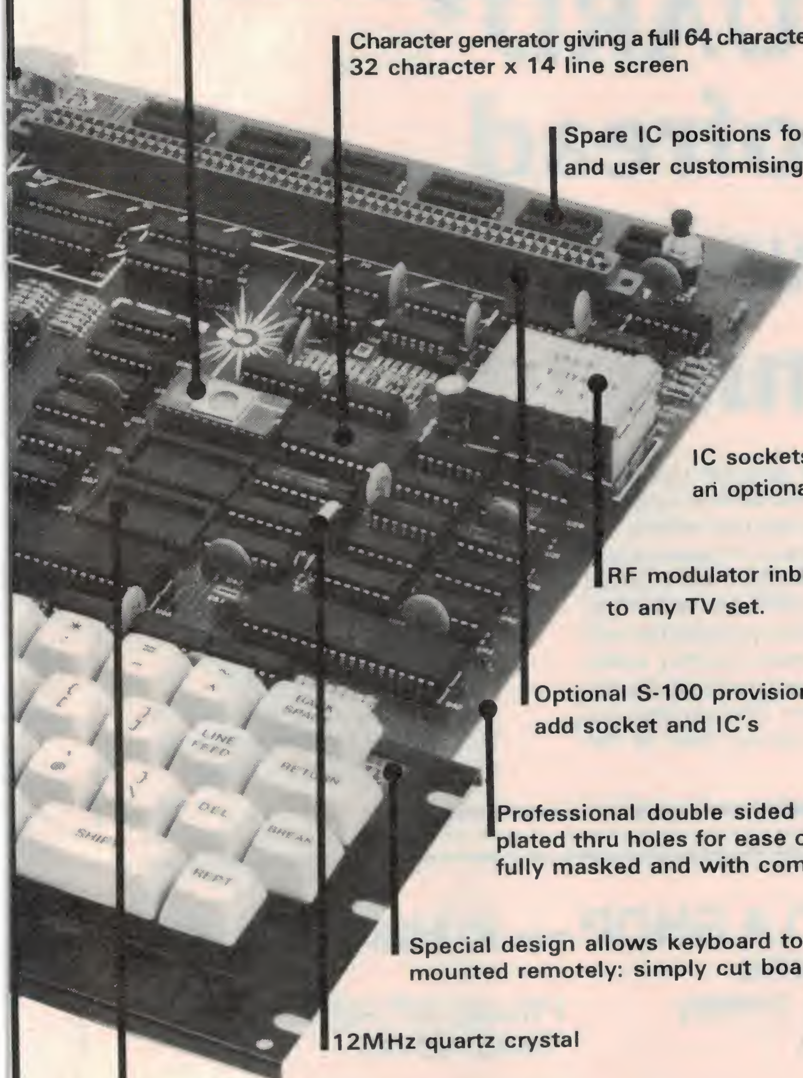
This is not a half baked design with no back up. The resources of Electronics Australia, Australia's most popular electronics magazine, and Dick Smith Electronics have combined to design and bring you this kit in the interests of computer enthusiasts actually building and not just buying. The design is fully Australian.

Imagine how much you will learn!

Most computer enthusiasts can program a computer but would have absolutely no idea of how to build one. By building this kit you will learn both the technical side of construction, how it works and then how to program. What a fantastic background for a future . . .

Sectional construction.

We have designed this kit not only for the serious computer user but also for first time users like the student or hobbyist. This is why we have a short form kit which may be added to as you build (and as you have the money!). For example, you may build the computer originally and operate it with 'BASIC on tape' and then add 'BASIC in ROM', add the S-100 and provide other parts at a later stage.



Relay to operate cassette unit automatically

2K Monitor program supplied

Character generator giving a full 64 characters 32 character x 14 line screen

Spare IC positions for prototyping and user customising

IC sockets available as an optional extra

RF modulator inbuilt: connects to any TV set.

Optional S-100 provision: simply add socket and IC's

Professional double sided PC board with plated thru holes for ease of construction, fully masked and with component overlay

Special design allows keyboard to be mounted remotely: simply cut board here

12MHz quartz crystal

Optional 9K SUPER BASIC in ROM simply plugs in here

Famous Z-80 microprocessor as used in Tandy & System 80 computers

*Copy of articles will be included when available from EA.

Comprehensive manuals available:

The construction details will be given in Electronics Australia magazine and full copy* of the EA article will be supplied with each kit. We also have available two very comprehensive manuals to assist in construction and programming:

Combined construction, assembly and technical manual.

Cat B-3600

$12.50

Cat B-3602

$14.50

Super 80 Basic does this:

Over 50 separate versatile commands. Features: arithmetic and integer functions user-defined functions, machine language routines, text editing, string operations. Also contains 25 error codes to assist you in programming.

'Super 80 Basic' reference manual

Short Form Kit

Designed for computer applications where 'Basic' programming is not required. Kit supplied with Eprom Monitor and 16K RAM. Cat. K-3600 **$289.50**

Add these items to make a fully operating computer system to your own requirements:

Transformer to suit M-2325 **$22.50**
BASIC program (interpreter) on cassette... .... K-3602 **$24.50**
IC Socket set (recom.) ... K-3603 **$12.50**
BASIC program in EPROM (set of 3 IC's)... .... K-3604 **$99.50**
S-100 Expansion K-3606 **$19.50**

Yes, this makes the full 16K computer with 9K basic on tape, transformer and IC Sockets — only — $349!

OPTIONAL EXTRAS ADDED: S-100 EXPANSION, IC SOCKETS, FULL 48K RAM

'Sorry Dick, It Doesn't Work'

All parts with this kit are guaranteed tested and new, but we cannot guarantee the labour content provided by you. If, after completion, your Super 80 fails to operate, you may take advantage of our 'Sorry Dick, It Doesn't Work' service.

Our Service Centre will check and repair your Super 80 for a lower than normal service fee. This fee includes any necessary replacement of components, etc.

If you send your Super 80 to us under the 'Sorry Dick, It Doesn't Work' service, **it must have been constructed using IC sockets.** If we receive a kit which does not use IC sockets, or if the kit is so badly constructed as to make effective repair impossible, we reserve the right to return your kit in the condition received, together with the service fee.

Under our 7 day satisfaction guarantee, you may return any kit in its original condition for a full refund of the purchase price. We cannot give a refund once construction has commenced, if any internal packs of components are opened or if the carton or kit is damaged.

7 DAY SATISFACTION GUARANTEE

Purchase this kit and inspect it for up to 7 days. If you do not wish to go ahead and construct this kit, simply return to us in condition as supplied and your money will be refunded in full.

DICK SMITH Electronics

DSE/A019/LM

SUPER 80 EXCLUSIVE TO DICK SMITH'S

NSW AUBURN 648 0558 • BLAKEHURST 546 7744 • BROADWAY 211 3777 • BROOKVALE 93 0441 • CHULLORA 642 8922 • GORE HILL 439 5311 • NORTH RYDE 888 3200 • PARRAMATTA 683 1133 • SYDNEY 290 3377 • TIGHES HILL 61 1896 • WOLLONGONG 28 3800 **ACT** FYSHWICK 80 4944 **QLD** BURANDA 391 6233 • CHERMSIDE 59 6255 **SA** ADELAIDE 212 1962 **VIC** COBURG 383 4455 • MELBOURNE 67 9834 • RICHMOND 428 1614 • SPRINGVALE 547 0522 **WA** CANNINGTON 451 8666 • PERTH 328 6944

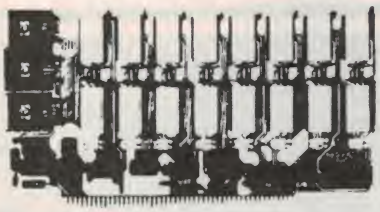
Mail Order Centre: PO Box 321, North Ryde 2113. Phone: (02) 888 3200

ROD IRVING ELECTRONICS

425 HIGH STREET, NORTHCOTE 3070, MELBOURNE, VICTORIA.

S100 COMPUTER PRODUCTS

16K EPROM CARD-S 100 BUSS



$89.50
KIT

BLANK PC BOARD
$45
USES 2708's!

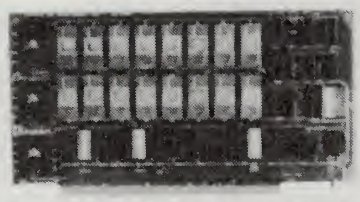
Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at **ALL TIMES!** Kit features a top quality soldermasked and silk-screened PC board and first run parts and sockets. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

OUR 450 NS 2708'S ARE $6.95 EA. WITH PURCHASE OF KIT

ASSEMBLED AND FULLY TESTED ADD $36

32K S-100 EPROM CARD

NEW!



$99.95

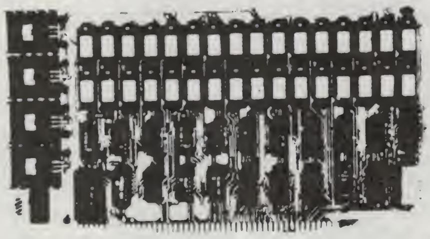
KIT
USES 2716's
Blank PC Board — $55
ASSEMBLED & TESTED
ADD $30

SPECIAL: 2716 EPROM's (450 NS) Are $8 EA. With Above Kit.

KIT FEATURES:
1. Uses +5V only 2716 (2Kx8) EPROM's.
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible.
4. Addressable as two independent 16K blocks.
5. Cromemco extended or Northstar bank select.
6. On board wait state circuitry if needed.
7. Any or all EPROM locations can be disabled.
8. Double sided PC board, solder-masked, silk-screened.
9. Gold plated contact fingers.
10. Unselected EPROM's automatically powered down for low power.
11. Fully buffered and bypassed.
12. Easy and quick to assemble.

16K STATIC RAM KIT-S 100 BUSS

KIT $189
A&T $219



KIT FEATURES
1. Addressable as four separate 4K Blocks
2. ON BOARD BANK SELECT circuitry (Cromemco Standard) Allows up to 512K on line
3. Uses 2114 (450NS) 4K Static Rams
4. ON BOARD SELECTABLE WAIT STATES
5. Double sided PC Board with solder mask and silk screened layout Gold plated contact fingers
6. All address and data lines fully buffered
7. Kit includes ALL parts and sockets
8. PHANTOM is jumpered to PIN 67
9. LOW POWER under 1.5 amps TYPICAL from the +8 Volt Buss
10. Blank PC Board can be populated as any multiple of 4K

BLANK PC BOARD W/DATA **$49**
LOW PROFILE SOCKET SET **$22**
SUPPORT IC'S & CAPS **$29**
ASSEMBLED & TESTED-**ADD $30**

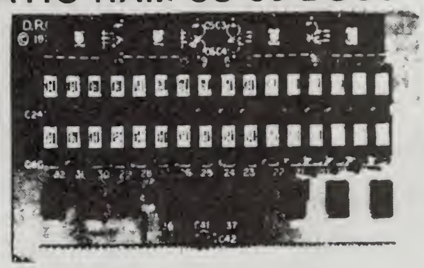
OUR #1 SELLING RAM BOARD!

16K STATIC RAM SS-50 BUSS

PRICE CUT!

$199 KIT
A&T $219

FULLY STATIC AT DYNAMIC PRICES



FOR SWTPC 6800 BUSS!

KIT FEATURES
1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Runs at Full Speed
4. Double sided PC Board Solder mask and silk screened layout Gold fingers
5. All Parts and Sockets included
6. Low Power Under 1.5 Amps Typical

BLANK PC BOARD —**$45** COMPLETE SOCKET SET — **$22** SUPPORT IC'S AND CAPS — **$45**

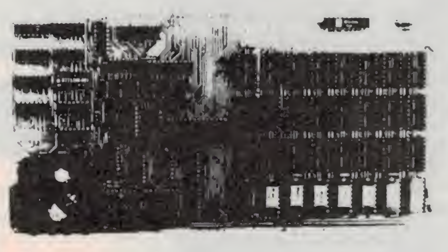
ITOH Model 8300 PRINTER

$790.00 plus 15% sales tax

This 80-column printer provided quiet operation, making it suitable for use in offices, classrooms and homes. Specifications include 125cps, 60 lines per minute, paper loading from bottom or rear and Centronics-compatible, parallel interface.

A bidirectional, dot matrix impact printer with a print head designed for 100% duty operation, assuring a print life that exceeds 100 million characters. The precision sprocket-feed mechanism permits printing forms from 4½ to 9½ inches wide. A 96 ASCII character set prints in upper and lowercase with the added capability of producing double-width fonts in boldface. The vertical format unit provides preprogrammed/programmable tab positions, top of form and bottom of form for complete formatting capabilities.

* * * AVAILABLE AGAIN * * *



- 16K Dynamic Ram Board
- Fully Expandable to 64K
- Assembled, tested and guaranteed
- S100 Compatible

16K Dynamic RAM Board assembled and tested: Special $269 plus tax (2mHz), $299 plus tax (4mHz) This must be the best offer available on quality tested dynamic RAM boards.

32K Assembled and tested	$309 plus tax (2mHz) $339 plus tax (4mHz)
48K Assembled and tested	$349 plus tax (2mHz) $379 plus tax (4mHz)
64K Assembled and tested	$389 plus tax (2mHz) $419 plus tax (4mHz)

ETI636 7 SLOT MOTHERBOARD WITH ACTIVE TERMINATION
Kit of Parts $89.00. Assembled and tested $115.00, inc tax.
RITRON COMPUTER GRADE POWER SUPPLY: +5V Reg, 10A, ± 16V Unreg. Kit of parts $79.95 inc tax A&T $99.95 inc tax

Write for list of other power supplies. Tax free prices also available.

Bankcard Mail Orders Welcome

ETI11/81

Please debit my Bankcard
Bankcard No.
Expiry Date
Name
Signature

General enquiries (03) 489-8131. Mail order enquiries (03) 481-1436. Ritronics Wholesale (03) 489-7099.

Prices current till November 1981. Heavier items add additional postage. Extra heavy items sent Comet freight on. Prices subject to change without notice. Send 60c and SAE for free catalogues. MAIL ORDERS PO BOX 135, NORTHCOTE, Vic 3070. Minimum pack and post $1. Telex AA 38897.

700ZXL

Peak Performance Redefined

A Triumph of Beauty and Technology

To carry the Nakamichi logo, a recorder must have special qualities. The 700 ZXL Computing Cassette deck is such a deck.

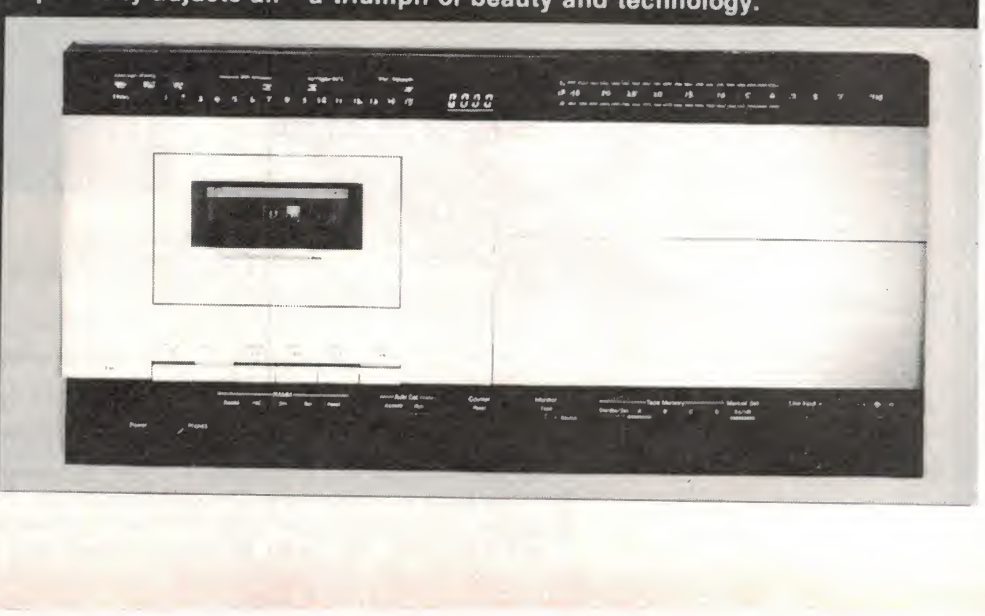
A marriage of classic beauty and technology is the essence of the 700 ZXL. Designed for the devotee of art as well as of music, the 700 ZXL will surprise you in its simplicity. All critical functions are carried out for you by computers.

For example, the time honoured art of user adjustment of a recorder to match each type of tape required test equipment and access to the right internal controls taking time and experience. But not with the 700 ZXL — its inbuilt A.B.L.E. auto calibration processor perfectly adjusts all four major recording parameters — azimuth, bias, level and equalisation for the tape you are using to achieve a 24 kHz response — and all with the touch of a button!

And with the 700 ZXL's new subsonic encoding technique, true error-free random access to any program on tape is now a reality.

And with Nakamichi's Diffused-Resonance transport, discrete 3 head technology, electronic tape counter, 50 dB range digital level meters and an optional remote control for all transport and RAMM functions, the 700 ZXL is truly a triumph of beauty and technology.

For complete information on Nakamichi's 700 ZXL Computing Cassette Deck, see your nearest dealer or write to Convoy International Pty Ltd, 4 Dowling Street, Woolloomooloo 2011.



Nakamichi

SIGHT & SOUND

No British blank tape levy

The British Government has decided not to impose a levy on blank tapes in order to be able to pay the recording companies whose records are often taped without authority. Although it is accepted that the recording companies are losing sales, the Government believes the extent of the losses is not known and cannot be measured.

In a Government Green Paper, lost record sales have been estimated to cost the recording companies perhaps £50 million per year, but re-covering such a sum by a levy would mean a large increase in the price of blank audio tapes and this is not regarded as fair to the many tape users who do not record copyright music. Even if a levy was made, it could be avoided by simply selling tapes and cassettes with pre-recorded trivial items.

However, the General Manager of the British Phonographic Industry has stated that the income of large numbers of musicians is being threatened by the failure of the Government to impose such a levy. He added that he did not understand why the Government claimed the losses of the recording companies could not be measured.

The Green Paper distinguished between video taping and audio taping; since current video machines cannot copy existing taped programmes unless they are being broadcast, there is no large threat to the manufacturers of pre-recorded video tapes.

The possibility of direct broadcasting from satellites has created some problems for the copyright lawyers, since there are two stages of transmission, namely up to the satellite and back down to earth. The material transmitted up to the satellite is not intended for public use and is not covered by copyright, but by chance the UK Wireless Telegraphy Act of 1949 makes the reception of such non-broadcast material an offence.

The Green Paper also considered the copyrighting of computer programs. Such material is often held on floppy disks, magnetic tape or on the surface of a chip, where it is less easily accessible than words on paper. However, the British Government intends to introduce new legislation to give computer programs the same copyright protection as literary works. It could however be argued that the displaying of information on a visual display unit is similar to the reading of a book in a library and should not be regarded as a breach of copyright, whereas the making of a 'hard' copy of material held in a computer should be a breach of the copyright laws in the same way that the photocopying of a book already is.

It is quite possible we may see these British decisions reflected in our own laws in the not too distant future — good news for audiophiles, but not so good for software bootleggers!

Brian Dance

Concept signs with CBS

Concept Audio recently announced the signing of a contract with CBS Records Australia Ltd in Sydney, involving the exclusive hi-fi store distribution throughout Australia of their Mastersound Half Speed Master series of recordings.

Immediately available are recent titles from Neil Diamond, Barbra Streisand, Billy Joel and Bruce Springsteen, and also some older titles such as 'Bridge over Troubled Waters' by Simon and Garfunkel and 'Tapestry' by Carole King.

Initially ten such titles will be available, but the catalogue will be expanded very rapidly to encompass some of the additional 200 titles that are available from West Germany, where the discs originate.

For further information contact Concept Audio Pty Ltd, 22 Wattle Rd, Brookvale NSW 2100 (PO Box 422, Dee Why NSW 2099). (02)938-3700.

Three new Yamaha amps and tuners

Yamaha Audio recently announced three new integrated amplifiers and matching tuners: the A-1060, A-560 and A-460 amps, and the corresponding T-1060, T-560 and T-460 tuners.

The A-1060 features Yamaha's 'X' power supply and gives 120 watts per channel, plus having many other powerful features, and retails at around \$1300. The 55 watts per channel A-560 retails at \$380, and the 35 watts per channel A-460 at \$270.

The tuners are all AM/FM stereo and retail at \$480 for the T-1060, \$240 for the T-560 and \$170 for the T-460.

For further information contact Yamaha/Rose Music, 17-33 Market St, South Melbourne Vic. 3205. (03)699-2388.

New sound level meter

A rugged and compact sound level meter from a British company, which is said to combine low cost with a high specification, is now being distributed in Australia.

A special feature of the instrument is that it can be set quickly and accurately to a reference level by means of a closed coupler unit which permits easy calibration of the meter.

Other characteristics of the Model CS 142C are a dynamic range from 35 dBA to 130 dBA, switched low or fast response, and the incorporation of a conventional 10 dB stepping attenuator with a scale from −5 dB to +10 dB. The microphone is of the air-dielectric type with a plastic diaphragm and 9 V polarisation.

A 9 V battery powering the meter provides for at least 80 hours of operation, and the instrument measures 175 x 55 x 60 mm, weighing 500 g.

Made by Castle Associates of Yorkshire, England, the CS 142C is distributed in Australia by Instrument Engineering Pty Ltd, 75 Grey St, Brisbane Qld. 4101, and by Paton Electrical Pty Ltd, 90 Victoria St, Ashfield NSW 2131 and 469 King St, Melbourne Vic. 3003.

New BASF quality tape

BASF recently introduced into Australia the high bias Chromdioxid Super II tape, claimed to consistently provide wider frequency response and less hiss or background noise than other tape types.

A spokesman for BASF claimed that extensive tests had shown the Super II cassettes to be superior in many respects to 'equivalent' competitive brands, and that in independent tests at the Festival du Son in Paris the Chromdioxid Super II had performed better than metal tapes which retail at almost twice the price.

The success of the Super II is said to lie in the development of new techniques in cassette body construction, based on BASF's long experience in the production of chromium dioxide tapes.

For further information contact BASF Australia Ltd, 55 Flemington Rd, North Melbourne Vic. 3051. (03)329-9555.

JANDS

J 1000 CS

POWER
AMPLIFIERS

SIX MODELS AVAILABLE	J 1000 (CS)	500w + 500w
	J 700 (CS)	350w + 350w
	J 400 (CS)	200w + 200w

"..... (this amplifier) may well prove to be the foremost technical development in 1981 for rock music in Australia"
E.T.I. October 1981

SESSION

METAL CASE HARDWARE
CORNERS — CATCHES — HANDLES

REAN

AMPLIFIER and CABINET FITTINGS

FOR FURTHER INFORMATION ON THESE and OTHER JANDS PRODUCTS

PHONE 516-3622

JANDS AUSTRALIA

578 PRINCES HIGHWAY ST. PETERS. P.O. BOX 78 ST. PETERS NSW 2044 AUSTRALIA

Large-screen colour video from Matsushita

Matsushita Electrical Industrial Co of Japan has developed an ultra-large-screen colour video display system for use in such areas as sports stadiums, auditoria, recreational areas, advertising billboards, promotional displays, theatre backdrops and public information displays.

The screen size of the standard model is 20.6' high by 27.5' wide (6.28 m x 8.38 m) — equivalent to the total screen size of approximately 440 20" TV sets! The screen uses 37 800 coloured bulbs (180 vertically and 210 horizontally) in high-density placement, thus producing high-quality vivid and bright pictures which can be viewed from as close as 170' (51.8 m). Optimum viewing distance is said to be 230' to 500' (70.1 m to 152.4 m). The brightness of the screen may be modified according to surrounding light levels, and images are said to be visible even in bright sunlight.

Many systems of this kind use cathode ray tubes, but Matsushita claims that the newly developed coloured bulbs, which are mirror coated to improve light efficiency, provide many technical advantages over CRTs. The high efficiency bulbs also feature a wide colour reproduction range (64 tone grades) and rapid on/off response.

The system consists of four main units: a central control, the image display, video image driving units, and a power unit. In the central control unit video images such as moving and still pictures supplied by video cameras, video tape recorders, etc, are processed and transmitted to the driving unit. The transmitted signals are converted into digital signals, which control the change of the electric current supplied from the driving units to the bulbs. According to the change of electric current, the bulbs are turned on and off to reproduce colour images on the screen. Text and graphics may also be displayed.

The large-screen system is said to be easy to install and maintain, and is equipped with an automatic lamp coil breakage detection system.

Matsushita have already received orders from Japan and overseas for the system, and the first one will be in operation towards the end of 1982 at the Nishinomiya Baseball Stadium near Osaka, Japan.

For further information contact Michelle Myers (Publicity Co-ordinator), National Panasonic (Australia) Pty Ltd, 95-99 Epping Rd, North Ryde NSW 2113. (02)887-0144, ext. 266.

New Hafler amp at Concept Audio

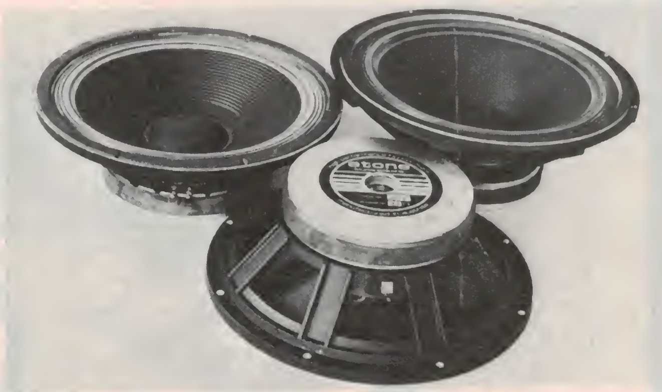
Concept Audio recently announced that the David Hafler DH-500 power amplifier would be available in Australia from October this year.

The DH-200 100 watt MOSFET power amp, introduced in Australia two years ago, proved extremely popular with audiophiles, particularly coupled with the DH-101 Preamplifier, and it is anticipated that the DH-500 will be received just as well.

The amp, which can deliver in excess of 255 watts RMS per channel, features a modular design and is cooled by a three-speed automatic fan. It has a rack-mounting front panel and is finished in the standard Hafler black.

At a slightly later date a bridging kit will be available to convert the DH-500 into a mono 800 watts RMS unit.

The unit will cost $1398 in kit form, $1498 assembled, and a detailed brochure, specifications and any further information may be obtained from Concept Audio Pty Ltd, 22 Wattle Rd, Brookvale NSW 2100 (PO Box 422, Dee Why NSW 2099). (02)938-3700.



Jaycar stocks Etone speakers

Jaycar now stock a wide range of Etone loudspeakers at their Sydney showrooms, ranging from 6" hi-fi types 605 and 608 through 10" and 12" units up to 100 watts RMS power handling capability.

Etone high-power speakers for PA use are also available, ranging in size from 10" through 12" to 15" and 200 watts power handling capability.

Jaycar also runs a free speaker cabinet advisory service; anyone interested is welcome to drop into Jaycar's showrooms and receive free design drawings of suitable cabinets for hi-fi enclosures, PA bass bins, foldback monitor boxes, etc. Country and interstate customers may participate by sending an SAE.

For further information contact Jaycar Pty Ltd, 380 Sussex St, Sydney. (02)264-6688.

Denon to sell Philips' digital disc

Denon recently signed an agreement with Philips of the Netherlands for production rights on Philips' Compact Disc Digital Audio System (CD System). Denon's line of home equipment is scheduled to be sold late next year.

It is said to make possible perfect sound reduction, far surpassing anything available today. Using a disc 12 cm (about 5 in) in diameter, with 60 minutes of program time on each side, an optical beam 'reads' the digitally encoded information on the disc, processes it through a decoder, and then sends the signal to the amplifier. This optical 'stylus' tracks a line of microscopic indentations (digitally encoded music) on a line only 1.6 microns in pitch, about 60 times narrower than the band on a conventional record. Because this line of information is tracked at a constant linear speed, the rotational speed of the disc varies between 200 rpm (at the outside edge) and 500 rpm (near the centre).

The result is said to be purity in signal characteristics, and disc surface variables, such as dust or fingerprints, will not affect the performance. And since there is no contact between the optical stylus and the disc, the recording will sound as good after many years of use — it never wears out!

Denon is also attacking the audio accessories market with a new combination: a stylus cleaner and a record cleaner.

The stylus cleaner has incredibly fine glass fibres that vibrate at approximately 400 Hz to safely clean off deposits that build up on a stylus under normal use. The base also functions as a level to check the positioning of the turntable.

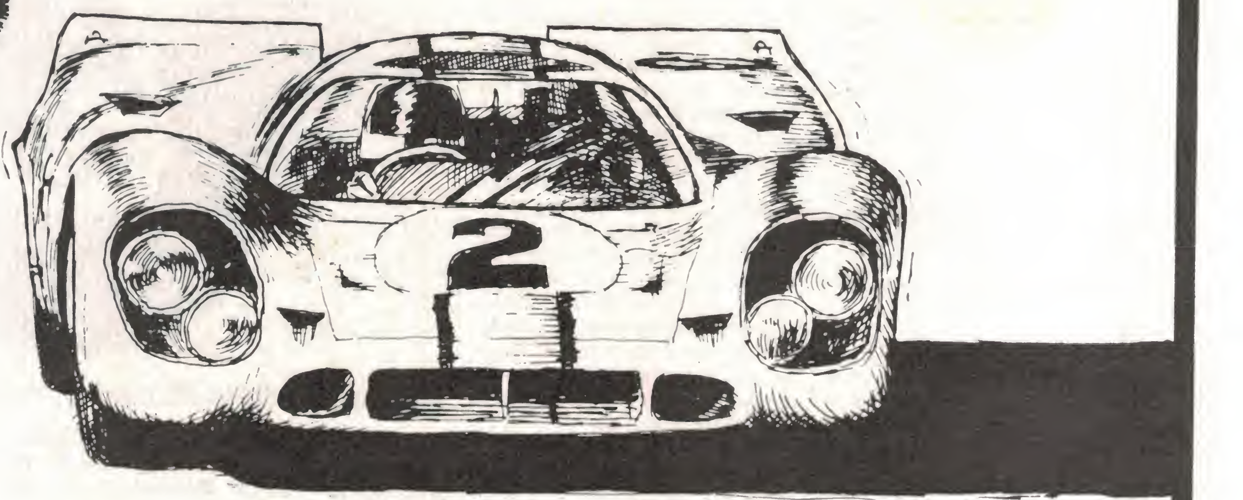
To keep records clean, an active vapour record cleaner is also available. Solvent is added to the base pad in the airtight case, causing the vapour of the solvent to be absorbed into the cleaning pad, enhancing the cleaning action without imparting solids to the record surface.

HotWires

POWER FOR YOUR CAR STEREO!

Get all the sound you paid for with

AUTOSOUND SPEAKER WIRE by MONSTER CABLE



ENGINE NOISE! ROAD NOISE! TRAFFIC JAMS!

You need to get the most out of your car stereo. HOTWIRES allow maximum signal transfer for increased power, dynamic range and musical clarity. Efficient coupling between amplifier and loudspeaker is essential with the relatively lower power output from car stereos. Our super tough Duraflex insulation makes for easy installation and provides a permanent protective jacket for HOTWIRES' unique 300 strand construction of high purity copper.

Get the most out of your car stereo

Get wired with HotWires by MONSTER CABLE

Available from leading Hi-Fi outlets and car sound specialists.

Distributed by Convoy International (02) 358 2088. Trade enquiries welcome.

The Personal Computer Your information window

An extension of your brain
An Apple Personal Computer puts you at the forefront of the technological revolution. Use it well and it will mediate the availabilities of a wealth of conceptual tools, data bases, communication channels and information processes. An Apple will help you simplify a myriad of tasks from ordinary data processing through information retrieval to economic forecasting.

Apple is versatile
Your Apple is an extremely powerful and robust problem solver backed by a comprehensive set of software programmes. Already, over 300,000 Apples are used for business, domestic, educational research and recreational purposes.

Apple as information processor
An Apple personal computer performs a full range of standard functions like statistics, word-processing, graphics, number crunching, filing, storage/retrieval and cross-referencing.

Apple as super-brain
Aside from the more pedestrian functions of retrieving and processing information, Apple performs other sophisticated functions such as econometric modelling, financial forecasting, graphics, topological modelling and trend analysis.

Apple is convenient
Apple is portable. It can be used at home or in the office. You can address it in ordinary English or gain full computer literacy in BASIC PASCAL, COBOL, FORTRAN or PILOT. Full step-by-step training comes with your Apple. If you can use a calculator and speak English, Apple shows you the rest.

Apple as communicator
Apple combines many of the functions of telephones, telexes, citizens' band radios and library access terminals.
It allows you the very latest access to data bases and information services and mail electronically locally or world wide.

Apple as challenger
Apple is fun. From a perfect game of Chess to Star Wars—not only for the children—preparing them for the future in this high-technology age.

Apple is cost-efficient
For roughly the price of a plain paper copier, you get a sophisticated, powerful machine, which not only processes numbers and words, but gives you direct access to a wealth of information through a rich network of data bases and direct communications with other computers.

Mail this coupon for an "Apple Pack" brochure or talk to your local Apple authorised dealer about the specific applications for you.
If the coupon has been removed, send your name and address to:
ELECTRONIC CONCEPTS PTY LTD,
55 CLARENCE STREET,
SYDNEY, NSW 2000

apple computer®

Mail to: PPCB374B
ELECTRONIC CONCEPTS PTY LTD,
55 CLARENCE STREET, SYDNEY, NSW 2000
Please send me a free "Apple Pack" brochure.

NAME ______
ADDRESS ______
______ POSTCODE ______
PROFESSION ______

PPLE APPLE = PERSONAL COMPUTER PERSONAL COMPUTER = APPLE APPL

NEW! FROM MOBILE FIDELITY SOUND LAB

GEO-DISC™

by mobile fidelity sound lab

THE STATE-OF-THE-ART CARTRIDGE ALIGNMENT SYSTEM. ACCURATE AND EASY-TO-USE.

Total alignment in moments, not hours.

Critical Alignment to within 762 microns (.003 of an inch)

Mobile Fidelity Sound Lab's GEO-DISC is the perfect complement to its series of Limited Edition Original Master Recordings. Both will markedly improve the sonic performance of your stereo playback system.

But the high fidelity pleasures of Original Master Recordings . . . even the audio content of conventional records . . . cannot be totally realised if your stylus/cartridge is not aligned accurately. That's where the GEO-DISC is essential.

A product of extensive research and development, the GEO-DISC features a proprietary three-dimensional visual alignment system that delivers incredibly precise, uncomplicated, rapid and economical cartridge alignment. It enables you to achieve critical alignment to within 762 microns (.003 of an inch) in moments, not hours. GEO-DISC exclusively adjusts the three most important factors of alignment: proper offset, proper tracking angle and proper overhang.

The detriments of an improperly-aligned cartridge are legendary and have no doubt affected all concerned listeners from time to time. These include:

- Severe loss of information, frequently lost permanently by groove damage from misaligned stylus.
- Tracking distortion—break-up of high acceleration information.
- Sibilance—break-up of "S" and "T" sounds.
- Phase distortion—inaccurate or lost imaging.
- Tracing error—Loss of subtle details in the recording.
- Frequency response distortion—Loss of some areas in audio band.

Overall, gross cartridge misalignment can result in very high Total Harmonic Distortion. The GEO-DISC can help solve these problems.

Available at discriminating audio stores. If your dealer does not carry GEO-DISC you may order direct.

SEND TO: EMERSON RADIO, 106 BELMORE RD.,
RIVERWOOD. NSW. 2210.

Please send me . . . . GEO-DISC(s) at $29.95 each.

Name: . . . .

Address: . . . .

City: . . . . State: . . . . Postcode: . . . .

TO ORDER BY MAIL, send cheque or money order payable to Emerson Radio. Allow 2 weeks for delivery. Postal deliveries are free. Personal cheques accepted but must await bank clearance before delivery will be made.

geo/8

The audio experts are raving about the Magnetic Field Amplifier

M-400 Magnetic Field Amplifier

"Its distortion and noise levels are entirely negligible . . . it's hardly conceivable that a small, inexpensive lightweight cube such as this could deliver as much clean power as any but a few of the largest conventional amplifiers on the market."

That's what Julian Hirsch reported in Stereo Review about the Carver M-400—the unique magnetic field power amplifier. It's a cube that weighs around 4 kgs and delivers 200 watts per channel. And costs a lot less than you think.

Equally startling, the M-400 can safely drive speaker-load impedance as low as 2 ohms. And in mono it can deliver more than 500 watts into an 8-ohm load, with peaks to 900 watts! (Bring on digital audio!)

To hear for yourself why all the audio experts have flipped over Carver, ask for a demonstration and descriptive literature. It will be a totally new experience for you.

CARVER
CORPORATION

DISTRIBUTED BY CONVOY SYDNEY (02) 358 2088

Available from:
N.S.W.: LEISURE SOUND City • Parramatta • Artarmon 29 1364
VIC: TIVOLI HI-FI Hawthorn 818 2872
QLD: STEREO SUPPLIES Brisbane 221 3623
S.A.: SOUNDCRAFTSMEN Hawthorn 272 0341
W.A.: THE SOUNDCRAFTSMAN Subiaco 381 5114

Not Just Speaker Wire

Conventional speaker wire limits the performance of your sound system by decreasing power output, restricting dynamic range, and reducing clarity and definition. You can significantly improve the performance of your audio system by switching from your present speaker wire to Monster Cable.

Constructed of over 500 strands of high purity copper in a unique configuration, Monster Cable is specifically engineered for low resistance, low capacitance, and low inductance. The Results?

Deeper, tighter bass.
Maximum power transfer.
Increased clarity and definition.
Wider dynamic range.

Even low-powered systems show a remarkable improvement. Recommended by leading audio manufacturers, Monster Cable is safe to use with all amplifiers and receivers, regardless of design.

Don't be deceived by imitations. If it doesn't say Monster Cable you're not getting all the performance you paid for.

MONSTER CABLE

DISTRIBUTED BY CONVOY SYDNEY (02) 358 2088

Available from: N.S.W. Leisure Sound, City • Artarmon • Parramatta 29 1364 • Russin Electronics, Ashfield 799 2421 • Woollahra Electronics, Woollahra 389 9625 • Pitman's, Wagga Wagga 25 2155 • Wollongong Hi-Fi, Wollongong 28 3773; **A.C.T.** Curatone Hi-Fi, Phillip 82 1388 • Kingston Hi-Fi, Kingston 95 7895; **VICTORIA** Tivoli Hi-Fi, Hawthorn 818 2872 • Natsound, Melbourne 67 3484; **QUEENSLAND** Stereo Supplies, Brisbane 221 3623 • Disco & Stereo Supplies, Townsville 72 4226; **SOUTH AUSTRALIA** Sound Craftsman, Hawthorn 272 0341 • Track Hi-Fi, Adelaide 223 7285 • Grenfell Plaza Hi-Fi, Adelaide 51 5017 • Blackwood Sound, Blackwood 278 0341; **WESTERN AUSTRALIA** The Audio Centre, West Perth 322 5177 • Japan Hi-Fi, Victoria Park 362 1466 • Soundcraftsman, Subiaco 381 5114; **NORTHERN TERRITORY** Radio Parts, Darwin 81 8508.

SIGHT & SOUND news

Bang & Olufsen meter available

The latest addition to the Bang & Olufsen range of electronic measuring instruments is the NM1 Signal-to-Noise Meter.

As well as many other features, the NM1 is claimed to be unique because:

- It has weighing networks and meter responses conforming to all internationally accepted standards
- It is the only meter on which an amplifier can be correctly loaded for 4 or 8 ohms and signal-to-noise measurement made.

As a multi-function instrument, the NM1 is said to be very suitable for measurements of signal noise on, e.g: amplifiers, AM/FM tuners, tape recorders, record players, various measuring equipment, hearing-aid devices, medical measuring instruments and many other types of AF equipment.

Trade price is $1270 plus tax, and further information may be obtained from Denis Cale, G.R.D. Group Pty Ltd, 698 Burke Rd, Camberwell Vic. (03)82-1256.

TDK open-reel tapes line-up completed

TDK (Australia) Pty Ltd introduced its new line-up of both the GX Studio Mastering Series and the LX Professional Studio Series of ¼" open-reel audio tapes in February 1981, and recently completed their series by adding GX50-120BM, GX50-60B and GX35-180BM models.

Coercivity of the GX series is set at 340 oersteds (27 kA/n) and remanence at 1400 gauss (140 mT). The GX series employs an exclusive graphite/carbon back-coating treatment which forms an extra-smooth coating that is said to lessen friction, assure easier tape winding, reduce modulation noise, and help to eliminate wow and flutter caused by slippage in the tape drive.

The possibility of dropout is significantly reduced because the treatment virtually eliminates electrostatic charges. As a result, dust is not likely to form on the tape's surface.

Recommended retail prices for the GX and LX series are: GX50-120 BM: $40.00; GX50-60 B: $16.70; GX35-180 BM: $47.00; GX35-90 B: $18.30; LX50-120 BM: $34.49; LX50-60 B: $15.30; LX35-180 BM: $38.16; LX35-90 B: $16.80; LX35-180 M: $34.49; LX35-90: $15.30.

For further information contact TDK (Australia) Pty Ltd, Unit 5, Level B South, 100 Harris St, Pyrmont NSW 2009. (02)660-4955.

Commercial tape degausser

The Bell & Howell TD-500 degausser is designed for the high energy tape user in the instrumentation, video and audio markets. The TD-500 is claimed to be the first automatic degausser capable of erasing tapes with a coercivity of up to 750 oersted.

The unit can be easily switched from 1" to 2" operation. For commercial broadcast operations the 2" setting is said to be satisfactory for all usage, but the instrumentation user who requires maximum possible erasure would need to set the tape width in use.

The TD-500 is derived from the well-proven TD-2903-4B, with a number of improvements:

- New heavy duty slide assembly
- New higher torque motor
- Improved reel hub assembly
- New heavy duty upper coil supports
- New solid-state logic assembly
- New heavy duty electrical components
- New over-temperature protection circuit

The standard TD-500 is configured for 3" NAB hubs; reel diameters are to 15" and tape widths from ¼" to 2". Accessory adaptors are available for other tape formats.

For further information contact Bell & Howell Australia Pty Ltd, 55-69 Murray St, Pyrmont NSW 2009 (GPO Box 4778, Sydney NSW 2001). (02)660-5366.

Vanfi expands

Keio International is a newly formed autonomous company within the Vanfi group, which has been formed to distribute products from the Crown Radio Corporation of Japan. These products include Crown Radio cassette portables, a new up-market range of hi-fi equipment called Vector Research, and the D.R. Industries range of loudspeakers, Silcron and R.M.S.

Initially in Australia (only the second country after America to market Vector), the Vector Research range will consist of four stereo receivers, three cassette decks and a graphic equaliser and turntable. This range will be complemented in the new year by a full product line of amplifiers, tuners and speakers, and by a cheaper range of products under the name of 'Bectus'.

The Crown range of portables and the Vector range became available from October this year. For further information contact Bruce Massie, National Sales Manager, Keio International, 19 Cardigan Place, Albert Park Vic. 3206. (03)699-1806.

SIGHT & SOUND news

Remote control and sound memory — whatever next?

Sharp's Optonica System 105, previewed at the recent Sydney Hi-Fi and Video Show, is claimed to be the most advanced digital sound system on the market.

It incorporates a sound control memory for individual settings in its tuner, turntable, amp, tape deck and speaker combination, and other major features include:

- fully remote controlled operation
- advanced digital technology.

The digital remote control unit is extremely compact and thin, and controls all the system's major functions. According to Mr. Geoff Muir, sales and production manager for Sharp hi-fi products, "The unit gives complete control. In fact, the only thing it won't do is change the records and tapes ... you can even change radio stations by remote control."

By containing all the amplifier's functions on pc boards, Sharp has managed to do away with many potentially troublesome mechanical components. Microcomputers also control the turntable speed and tonearm, the AM/FM tuner and the tape deck.

The Optonica System 105 is expected to retail at around $2300.

For further information contact Mrs. J.W. Lee Martin, Hutchinson Public Relations, on (02)922-6922.

Yamaha tape deck with dbx

Yamaha's new cassette deck, the K-960, incorporates dbx tape noise reduction circuitry, which is said to reduce noise on cassette tapes by as much as 30 dB with the push of a button during taping.

This deck also features Sendust record/play heads for better frequency response and reduced dropout and modulation noise, a double-gap ferrite erase head and metal tape capability.

Features include:

- dbx noise reduction
- Yamaha's low-impedance pure plasma process Sendust Rec/Play head
- double-gap ferrite erase head
- metal tape capability
- two-motor separate drive tape transport
- IC logic control
- fluorescent bar-graph peak meter
- continuously adjustable bias control
- timer recording switch
- subsonic and MPX filters
- Dolby noise reduction
- low-noise equaliser amp
- focus switch to extend high-end frequency response or improved phase coherence.

The suggested retail price is $500, and more information may be obtained from Yamaha/Rose Music, 17-33 Market St, South Melbourne Vic. 3205. (03)699-2388.

New cassette deck from Sanyo

The Sanyo RD 10 stereo cassette deck is a new release from Sanyo, and features metal tape capability and Dolby noise reduction for a recommended retail price of $116.

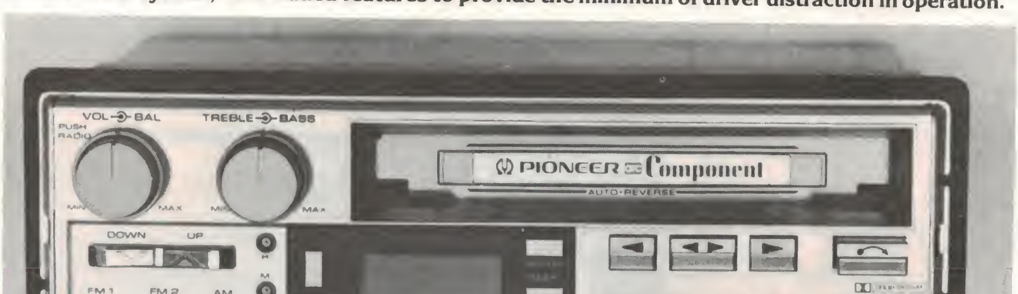
Finished in a simulated wood grain cabinet with a brushed silver front panel, the RD 10 also features:

- Two heads
- Full six-function controls
- Auto stop
- Separate left and right microphone input sockets
- Soft eject
- Headphone socket.

For further information contact Mr. R. Hopwood, Sanyo Australia Pty Ltd, 225 Miller St, North Sydney NSW 2060. (02)436-1122.

Pioneer car cassette player — minimum driver distraction

The KEX-70 AM/FM cassette component is claimed to have been designed for true hi-fi quality in a car sound system, with added features to provide the minimum of driver distraction in operation.



An illuminated cassette loading door provides easier access for night driving, and a remote station control enables the driver to locate a radio station without taking his eyes off the road. Other features include standard Dolby, chrome and metal tape capability and C-90 cassette mechanism.

The tuner section features a station memory for ten FM and five AM radio stations, and has a digital frequency readout which converts to a digital clock at the touch of a button.

Recommended retail price is $599, and more information may be obtained from Pioneer Electronics Australia Pty Ltd, 178-184 Boundary Rd, Braeside Vic. 3195. (03)580-9911.

Heavy.

Introducing another Sony only. The MDR series open-air headphones. The smallest, lightest stereo headphones available today. Or tomorrow.

With our lightest at 40 grams, you will barely know you're wearing them. Yet the sound is dynamite.

Through a remarkable new audio breakthrough, our engineers have succeeded in reducing big-headphone technology down to the size of your listening channels.

The MDR series headphones' airy spaciousness delivers absolute clarity through an ultra-small driver unit that produces more than three times the energy of conventional circuits. And a new high-compliance diaphragm accurately reproduces the 20 to 20,000Hz bandwidth and improves low-range response.

That means you can listen to the heaviest of music for hours. Lightly. And know that you're hearing every nuance of the original recording from deep bass to the highest treble.

Listen to our new MDR series headphones. They're light. And heavy.

STEREO HEADPHONES
MDR

AP3528


HITACHI
90
SX
HITACHI
SR
ME

RARE ADDITIONS FROM MARANTZ. SLIMLINE AMPLIFIERS.

Rāre: very valuable.
Addi'tions: the things added.
Mar'ăntz: a range of ultra-high performance Slimline and three-quarter size Amplifiers which blend state-of-the-art engineering with operational versatility.

Although all units in a hi-fi system must be compatible in order to achieve optimum sound quality, there is no question that their final standard of performance relates directly to the main amplifier. It is the heart of the system and the point at which distortion is most likely to be introduced.

Marantz engineers have developed special techniques for reducing the various forms of distortion to miniscule levels. This is achieved by the use of a highly efficient negative feedback system and operation in class AB, with the careful selection of "shortest path" wiring to avoid interaction between different stages in circuitry and with the other channel.

The more powerful models are equipped with a heat-loop cooling system for the output stage transistors. This NASA invention enables the heat dissipated at high power levels to be rapidly removed so that a considerably improved power-to-size ratio is obtained.

If you see your hi-fi as an investment and, if you demand critical performance standards as well as the best value for money, listen to the future.

Listen to Marantz.

marantz
Now you're listening.

Distributed by MARANTZ (AUST) PTY. LTD.
19 Chard Road, Brookvale, N.S.W. 2100
Telephone (02) 939 1900 Telex AA24121
Melbourne (03) 544 2011 Brisbane (07) 44 6478
Adelaide (08) 223 2699 Perth (09) 276 3706

High performance audio power amplifier

Department of Aeronautical Engineering,
University of Sydney.

This article, which previously appeared in Australian Electronics Engineering, Sept. 1980, describes the design of a very high performance 25 W audio power amplifier featuring low harmonic and crossover distortion, very stable bias current, large open-loop bandwidth to avoid transient intermodulation distortion, very good square-wave response with capacitive loads and relatively simple design.

L. Stellema

THE DESIGN of audio amplifiers is undergoing considerable change, stimulated by requirements for lower distortion and greater stability.

In this article the design of a high performance 25 W power amplifier is described and its performance figures given. The amplifier has extremely low harmonic and crossover distortion, and by a combination of thermal coupling techniques and circuit design, very high stability of bias current is achieved. The circuit also has the advantage of being relatively simple.

To achieve low crossover distortion, two steps are taken. Firstly, open-loop bandwidth is made rather high (15 kHz). Since crossover distortion consists of narrow spikes, feedback is not very effective in reducing these if the open-loop bandwidth is low. Secondly, instead of using conventional Darlington amplifiers in the output stage, the output transistors are driven by emitter followers that have constant current loads. This greatly improves the high frequency characteristics and also provides output current limiting.

Low harmonic distortion of the complete amplifier is achieved by designing each amplifier stage to give low distortion and to have a linear input resistance.

The relatively large open-loop bandwidth should provide low transient intermodulation distortion.

Thermal stability of the output stage bias current is kept very high by thermally coupling each emitter follower with the output transistor that it drives. For that purpose, driver and output transistors should be in identical suitable packages (e.g: TO-126, TO-220, SOT-93, etc.) and be of complementary types.

Circuit description

For convenience, the amplifier is split into two parts: a voltage amplifier and a voltage follower (the output stage). The voltage amplifier is built on a printed circuit board, while all transistors of the voltage follower are mounted on one heatsink, Philips or Mullard type 35D2CB(≑3.4°C/W). Fastened to the heatsink is a small printed circuit board containing the passive components of the voltage follower. Thus the two parts can be tested separately.

A patent covering the circuitry of the amplifier has been applied for.

Voltage amplifier

The circuit of the voltage amplifier is shown in Figure 1.

Transistors Q2 and Q3 are connected as a long tailed pair and are preceded by emitter followers Q1 and Q4. This circuit was chosen because of its inherent low distortion and also because the complete power amplifier is connected as an operational amplifier. This circuit is very suitable as a first stage for such use.

The complete power amplifier is an inverting one, the virtual earth point being at the base of transistor Q1. For this reason the input signal seen by transistor Q1 is extremely small and distortion due to large common mode voltages encountered in some circuits is avoided. Because distortions in transistors Q2 and Q3 cancel to a large extent and the input voltage is very low, the long tailed pair does not need local feedback in the form of emitter resistors.

The input resistance is determined by resistor R1 (22k). Capacitor C1 sets the low frequency 3 dB point at 10.6 Hz. The terminal marked 'feedback' is connected to the similarly marked terminal in Figure 2. Capacitor C4 is chosen to provide a closed-loop high frequency 3 dB point at 48 kHz. Transistor Q1 provides a high input impedance to reduce problems related to offset current and non-linear loading of the virtual earth point. Transistor Q4 serves to compensate for the voltage drift due to temperature variations in transistor Q1. The gain of the first stage is 175.

The emitter followers (Q5 and Q6) prevent the reduction of gain of the first stage due to loading. Of more importance, they reduce the distortion of the voltage amplifier because the load presented by the input resistances of transistors Q7 and Q8 is sufficiently non-linear to cause distortion despite the relatively large emitter resistors R23 and R24 and the push-pull configuration. The emitter followers also

VOLTAGE AMPLIFIER

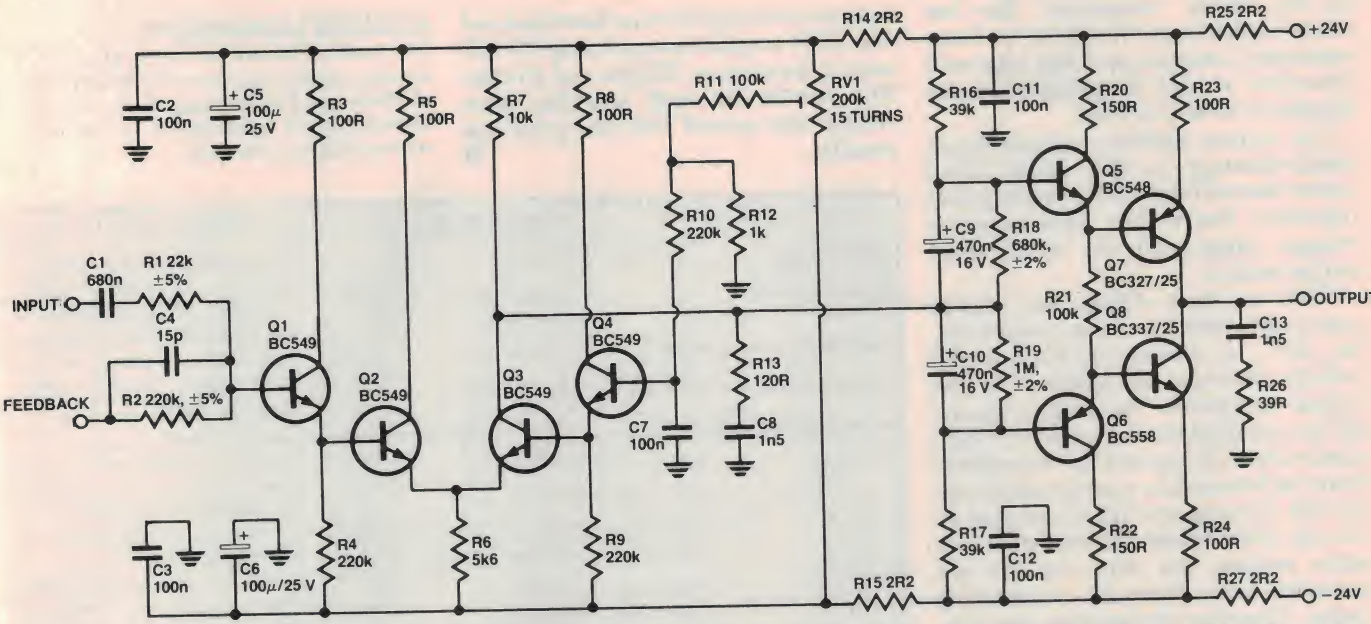


Figure 1. **Voltage amplifier. Note that R1, R2, R18 and R19 are metal film types. Capacitors C9 and C10 are tantalum or plastic foil types.**

PARTS LIST

All resistors used are ±5% ¼W carbon film types unless specified otherwise.

VOLTAGE AMPLIFIER

Resistors

R1	22k
R2,R4,R9,R10	220k
R3,R5,R8, R11, R21	100k
R6	5k6
R7	10k
R12	1k
R13	120R
R14,R15,R25,R27	2R2
R16,R17	39k
R18	680k, ± 2%, metal film
R19	1M, ±2%, metal film
R20,R22	150R
R23, R24	100R
R26	39R
RV1	200k, 15 turns

Capacitors

C1	680n
C2,C3,C7, C11,C12	100n
C4	15p
C5,C6	100u/25 V
C8,C13	1n5
C9,C10	470n/16 V tantalum or plastic foil

Semiconductors

Q1-Q4	BC549
Q5	BC548
Q6	BC558
Q7	BC327/25
Q8	BC337/25

stabilise the quiescent current through transistors Q7 and Q8, because changes of the base to emitter voltages of these transistors, due to variations in ambient temperature, are compensated by the change in the base to emitter voltages of transistors Q5 and Q6. The emitter followers also prevent reduction in bandwidth due to Miller capacitances of transistors Q7 and Q8.

The quiescent current through transistors Q7 and Q8 is approximately 10 mA. At full output, the current in each transistor swings between 5 mA and 15 mA. A higher quiescent current would result in lower distortion; however, as medium-power transistors with a relatively high f_T should be used, a compromise of 10 mA was made.

Harmonic distortion in the second amplifier stage is very low due to the fact that it is a push-pull amplifier and the emitter resistors R23 and R24 are of relatively high value.

Capacitors C8 and C13 are for frequency compensation. With the chosen values, the open-loop high frequency 3 dB point of the complete amplifier is 15 kHz. The resistors R13 and R26 reduce the phase shift at those high frequencies at which the reactance of the capacitors becomes very low, thus increasing the stability. Without these resistors, the capacitors must have a much higher value.

The second stage is coupled to the first via two capacitors C9 and C10 and via the dc attenuator, consisting of resistors R16, R17, R18 and R19. When the zero set control, RV1, is set for zero output voltage, the voltage at the collector of transistor Q3 is approximately 4 V and the collector currents of transistors Q2 and Q3 are approximately equal, due to different values being used for resistors R18 and R19. Owing to the use of the dc attenuator, the zero set control can be used for the whole amplifier and the setting is very uncritical. If the base-emitter voltages of transistors Q1, Q2, Q3 and Q4 are roughly matched, no zero set control is required, except when trouble-shooting with the feedback loop removed.

Components R14, R15, R25, R27, C2, C3, C11 and C12 prevent high frequency oscillation due to parasitic coupling via the supply leads. Electrolytic capacitors C5 and C6 are employed for decoupling purposes.

The gain of the voltage amplifier when loaded with the voltage follower is 5000. With the compensation capacitors C8 and C13 removed, the high frequency 3 dB point of the first stage is 220 kHz and that of the complete voltage amplifier 180 kHz when loaded with the voltage follower.

Resistors R3, R5, R8, R20 and R22 are used to stop any possible oscillation due to lead inductance, to limit collector currents in case of breakdown, and to aid in trouble-shooting.

Voltage follower

The circuit for this stage (output) is shown in Figure 2.

Output transistors Q5 and Q6 are driven by emitter followers Q1 and Q3, which are also loaded by constant current loads (Q2 and Q4). This produces source resistances for the output transistors which at all times (even when the output transistors are switched off) are very low. The constant currents selected by resistors R5, R6, R7, R8 and R9 should be higher than the worst-case peak base currents required ▶

by the output transistors. The low source resistances result in a lower harmonic distortion and less crossover distortion at high frequencies because of reduced switching time.

The emitter follower transistors are complementary to the output transistors they drive to avoid output power reduction due to the base-to-emitter voltage drops and for temperature compensation.

With no input signal, the voltage across the bias trimming potentiometer, RV1, is almost identical to the voltage between the emitters of the output transistors. Transistors Q3 and Q5 are mounted on the heatsink using a single screw. Transistor Q5 is insulated from the heatsink by a mica washer and the tab of transistor Q3 is mounted on the tab of transistor Q5, insulated by a mica washer. All mica washers are smeared with thermally conducting paste. Therefore the junction temperature of transistor Q3 follows that of transistor Q5. Transistors with a hole in them (TO-126) can be mounted together with the metal side of the emitter followers fitted against the insulated side of the output transistor. No mica washer is required, but the use of thermally conducting paste improves the thermal coupling.

The ideal bias current for an output transistor is a current that produces 25 mV across each emitter resistor. Since this emitter resistor is one-quarter ohm, the bias current should be 100 mA. However, since the emitters of the transistors will have some small ohmic resistance, a 90 mA bias current was chosen. The bias current value is not critical at all.

The components L1, C3, R14 and R15 are the normal output stabilising components. The feedback is taken from the junction of resistors R12 and R13. These resistors are used to avoid using an unsuitably high value for resistor R2 in Figure 1. When both resistors are equal (say 4k7) the closed loop gain is 20.

The resistive network consisting of resistors R1, R2, R3 and R4 and trimming potentiometer RV1 provides a load to the voltage amplifier which is much lower than the relatively high but slightly non-linear input resistance of the emitter followers (Q1 and Q3). This keeps the distortion low.

Conclusion

A power amplifier designed according to the circuit as described in this article has an extremely high performance. This was confirmed by the results of tests on two amplifiers as described and two 15 W amplifiers employing TO-126 output transistors BD235 and BD236. The results for each amplifier were similar and agreed with the given test results. ●

ACKNOWLEDGEMENT

The author wishes to thank Mr. C.T. Murray, senior lecturer in the Department of Electrical Engineering, University of Sydney, for his expert advice, which was very valuable in this work.

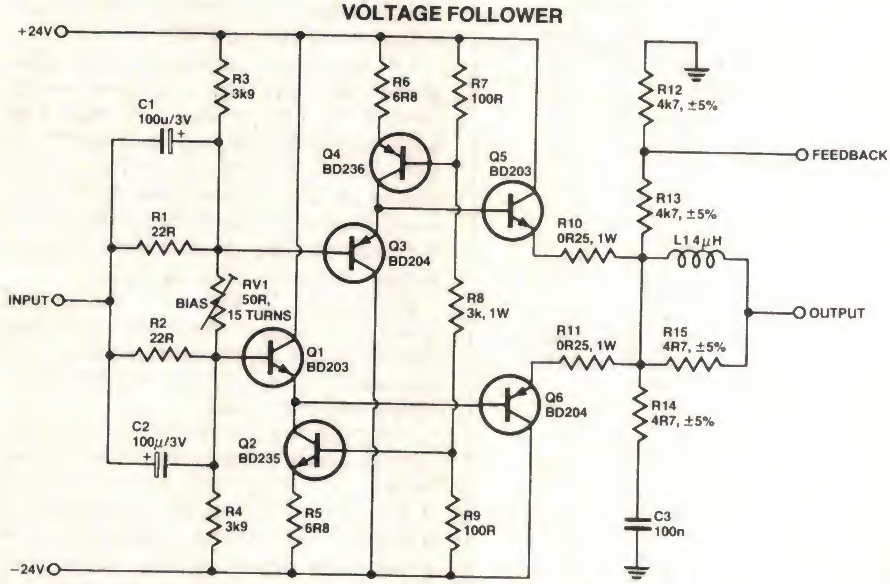
TEST RESULTS

Open-loop gain:	5000	
Closed-loop gain:	Minimum 10 (with circuit values given 20)	
Open-loop frequency response:	10 Hz to 15 kHz	
Closed-loop frequency response:	10 Hz to 48 kHz	
Harmonic distortion at 1 kHz, 10x:	0.001%	
1 kHz, 20x:	0.002%	
1 kHz, 100x:	0.01%	
1 kHz, 5000x:	0.5%	
10 kHz, 10x:	0.004%	
10 kHz, 20x:	0.008%	
10 kHz, 100x:	0.04%	
10 kHz, 5000x:	1%	

All distortion figures were measured at just below the onset of clipping, which was at 25 W or slightly higher, with a load resistance of 8 ohms. As output power is reduced, the distortion goes quickly below measurable levels.

Square-wave response:	Rise and fall times are 7 μs. The shape is perfect with no overshoot or ringing with a capacitive load between 0 and 0.47 μF.
Bias current stability:	Maximum change in bias current is ±1.5 mA or ±1.7%.
Test conditions:	1 hour at zero output power followed by 1 hour at 10 W output power (maximum dissipation of output transistors).

VOLTAGE FOLLOWER



ALL TRANSISTORS ARE MOUNTED ON ONE HEATSINK, PHILIPS OR MULLARD TYPE 35D2CB (= 3.4°C/W)

Figure 2. **The voltage follower stage. Note that R12 and R13 are metal film types, while R14 and R15 are carbon film types.**

VOLTAGE FOLLOWER

All resistors used are ±5% ¼W carbon film types unless specified otherwise.

Resistors
- R1,R2 .... 22R
- R3,R4 .... 3k9
- R5,R6 .... 6R8
- R7,R9 .... 100R
- R8 .... 3k, 1 W
- R10,R11 .... 0R25, 1 W
- R12,R13 .... 4k7, ±5%, metal film
- R14,R15 .... 4R7, ±5%, 1 W, carbon film
- RV1 .... 50R, 15 turns

Capacitors
- C1,C2 .... 100u/3 V
- C3 .... 100n

Semiconductors
- Q1,Q5 .... BD203
- Q2 .... BD235
- Q3,Q6 .... BD204
- Q4 .... BD236

All transistors are mounted on one heatsink, Philips or Mullard type 35D2CB (≑ 3.4°C/W).

Miscellaneous
- L1 .... 4 uH

The VT-6500 Portable Video System. Smaller. Lighter. Really portable. And it's got all the features you'd find on larger, heavier units. Because at Hitachi, we've put our know-how in electronic integration to work on our video cassette recorders. So less size doesn't mean less features. The recorder and tuner/timer are separate units. Take the recorder and one of our compact cameras along with you to get all the fun on tape. When you get back home, you've got the full-function convenience of a large-sized VTR. Performance and reliability are also up to Hitachi's remarkably high standards. The VT-6500 from Hitachi. The greatest little thing in VTRs yet.

Full-Function VTR Goes Portable


Preset Programming
Leave for 3 weeks, still record 8 programs.
Creative Freedom
Use a Hitachi home video camera to make your own shows.
LSI
Reliability
Hitachi is famous for it. The VT-6500 is built to last.
Visual Search
Find scenes quickly and easily.
Still Picture/ Frame Advance
Study your form in detail.
Remote Control
Thin, hand-size, 13-mode remote control unit.
VK-C600
VK-C800
A-V60
VT-TU65
20:00
OPERATE
AUDIO DUB
STOP
REW
FF
VISUAL SEARCH
REC
A.DUB
STILL PAUSE
FRAME ADV
SLOW
SPEED
FAST
TRACKING
HITACHI REMOTE CONTROL
PORTABLE VIDEO CASSETTE RECORDER
-6500
HITACHI

Carver M400 magnetic field power amplifier

The M400 embodies a totally new concept in amplifier design, pioneered by its designer Bob Carver. It is claimed to overcome distortion problems and is based on a completely new approach to the basic power supply.

Louis Challis

OVER THE LAST two years no amplifier has produced as much market and consumer interest as the Carver Model M400 Magnetic Field Power Amplifier. It has raised many eyebrows, not the least our own, and created many arguments as to the merits of the original American music power rating, continuous sine wave or RMS power ratings and the approach promoted by Bob Carver in marketing and developing this particular unit.

History

When the first transistorised amplifiers came out some twenty years ago the purists and musicians amongst us were quick to tell you that we could detect a difference in sound between those newfangled amplifiers and that produced by the best valve amplifiers. That difference in sound was, as we now know, primarily the result of class B operation crossover distortion, which produced a subtle difference in sound that was audible and, for many people, disturbing. As amplifier designs improved not only did designers overcome those problems of crossover distortion, but the best transistorised amplifiers' THD distortion figures have improved to the point where no valve amplifier can readily touch them.

Now, out of the blue, Mr. Bob Carver came up with a new amplifier design, with which he claimed to have obviated all those nasty problems of the first generation transistor amplifiers. This design is based on a difference in approach for the basic power supply and an even stranger approach for solving the distortion and crossover problems.

The M400

The Carver amplifier is exceptionally small, with dimensions that really belie its potency and capabilities. This, however, is really a secondary attribute compared with its design philosophy. Unlike other amplifiers, which work on the principle of stable or regular dc supplies and are then used with either class A, B, AB or lesser-known circuit techniques in the output stage to achieve the stated output, the Carver Model M400 uses an entirely different approach. According to Bob Carver, the main reason underlying his development of the 'Magnetic Field Amplifier' (as he dubbed it) was the need to produce an amplifier which achieved a far higher efficiency through varying the dc supplies to follow reasonably closely the actual acoustical output required by the amplifier.

This is achieved by what Carver describes as a form of commutation (switching), where the positive-going and the negative-going excursions of the output signal are derived from three separate dual power supplies operating at voltages of ±25 volts, ±50 volts and approximately ±80 volts. The output power signal is then controlled by the input signal to produce a step-wise excitation, with three steps of the voltage supply to the positive and negative output rails of the main output transistors. This signal is then modified by an amplified feedback circuit, which acts as a low power control amplifier, to remove the distortion components (from the 'steps-and-stairs' type waveform applied to the output circuitry) and achieve a faithful and low-distortion equivalent of the amplified input signal.

If this sounds more complex than a normal amplifier, it unquestionably is, but the important thing is that the system works and, all things being equal, works fairly well.

There are two problems with such a system. The first relates to the commutation noise which normally occurs *at frequencies lying in the audible range* and above, which consequently can be a source of intermodulation noise. The second is that the power handling capacity of the amplifier is geared to what can be described as a 'music power rating' rather than a continuous power rating. This can be likened to using a very high-powered amplifier with smaller than normal heatsinks, which can provide normal output power on the peaks of the signal but not on a sustained or continuous basis.

Carver's design philosophy, of course, was that this amplifier would not be used by rock groups, or by people needing servo-amplifiers or to drive foghorns, but rather for people interested in playing music, where the music does not have a continuous background high level, but rather is 'real' music.

The first version of this amplifier which I saw was a bright anodised unit. With the latest black version, featuring two simple arrays of light emitting diodes on the front face, and four speaker terminals and two coaxial input terminals on the rear face, one appreciates that this has been designed *for the utmost in simplicity*. On reading the handbook, you are aware that the designer has taken great pains to incorporate a series of protection circuits to stop you from destroying the amplifier even if you do not read the handbook.

It thus contains an over-current trip circuit, a clipping detector, a differential low frequency trip circuit, an over-voltage trip circuit, an over-temperature trip circuit and a dc fault trip circuit. In practical terms one does not have access to any of these circuits,

All the interconnections are clearly explained on the rear of the M400 for either mono (bridged) or stereo operation.

for when they operate it is only necessary to remove the fault or to let the amplifier cool down for it to reset itself into the normal operating mode.

The output connections for the speakers are wired differently to those with which most of us are familiar. The black terminal of the right channel pair is at ground, whilst the left channel grounded terminal is coloured red. The two channels of the amplifier thus deliberately deliver out-of-phase signals compared to one another and the terminals are thus marked with the reverse colour code in order to provide the correct phasing compared with the input signal. For mono operation the two input signals are combined at the coaxial circuits and the output is taken from the two furthest sockets, with the two inner terminals already being grounded in the chassis connection. Provided one follows the normal colour coding procedures in connecting the speakers, the system works quite normally and without problems. The back panel presents clear instructions on how to connect the speakers correctly and how to make a mono connection should this be required.

Measuring problems

The previous version of this amplifier, which was virtually a prototype 240 volt unit, provided us with the opportunity to evaluate many of the most important claims made by Carver for the unit. The first of these related to its power output capability, which we had some difficulty measuring at first. The theoretical approach that one would normally employ of applying a steady state signal at maximum power level is inapplicable and electrically unacceptable to this particular amplifier unless you can do it *very fast*. We had to revert to driving the amplifier with tone burst, whose distortion components and power working level characteristics were the subject of considerable time, effort and some ingenuity.

The first Model M400 we saw (Serial No. 7255) was an Australian prototype (that is, a prototype of what was intended for sale in Australia) and it produced a considerable level of commutation noise that was audible, even to an untrained ear. That unit was returned to the agents and some two months later a new production model (Serial No. 9956B) turned up for re-evaluation. It is this unit that we are reviewing and our comments relate entirely to it.

On test

The objective testing of the M400 provided us with the opportunity to re-apply the measurement techniques, which we had refined in the intervening period, especially to be able to accurately determine the 'real parameters' of this amplifier. Obviously frequency response tends to be a second-order factor in the evaluation, and so it was, as our measurements showed that the performance of the amplifier is within 3 dB from 1 Hz to 86 kHz.

If one measures the harmonic distortion in the normal manner, that is by evaluating the second, third, fourth, fifth and higher order harmonics as we normally do, the distortion products at the rated power of 201 watts and at the normal 1 watt level are *exemplary*, and if anything better than the manufacturer has previously claimed. Thus the total harmonic distortion is never more than 0.02% at the three test frequencies at 201 watts, and is 0.03% at 6.3 kHz in the case of the 1 watt level.

This, however, is not the full story, for when one closely examines the spectrum analysis produced by the real time fast Fourier analyser which we use in this mode of operation, one sees that there are commutation products which, if they were capable of being measured by a normal noise and distortion meter, boost the total indicated noise and distortion products to a far higher figure, more typically 0.3% than 0.03%.

It is possible to argue that these commutation noise components, which are readily measurable and also readily visible in the analysis procedure, are not 'true' harmonic distortion components. It is most probably equally true to argue that they come as a result of the mode of generation of the power supply signal and thus are really a form of intermodulation noise. This intermodulation noise then interacts with the test signals being used for the distortion analysis and is bordering on the audible under special conditions which relate to the level of the input signal. Obviously, with music being generated these components would be even more pronounced and undoubtedly more readily measurable if one happened to pick the right sort of spectrum and generate it in the right sort of way. When subjected to a normal intermodulation distortion test there is no denying that the intermodulation components are not readily measurable and so in this respect the manufacturer's claims are most certainly proved.

When it comes to noise and hum levels, if one follows the standard procedure of putting in a signal corresponding to the 1 watt level, and then measuring the noise components related to that, it is clear that the unweighted level is −82 dB and that the A-weighted level is −84 dB. This falls short of the very best amplifiers that we have evaluated, but even more significantly it avoids the key issue of what happens in the amplifier when it is subjected to a *real* signal. Under these conditions our measurements showed that the noise level (if we can describe it as that) rises rapidly and is typically −55 dB down with respect to the peak signals at maximum output level. This shows up in photo B in the form of commutation background noise, which does not occur in a more conventional amplifer. It is at least 25 dB higher than in a conventional 'run of the mill' amplifier and at least 35 dB higher than in the very best amplifiers we have tested.

The maximum power output capability is *every bit as good* as the manufacturers claim, and the clipping level occurs at 248 watts output into an 8 ohm load. Under these conditions there is a 0.9 dB headroom relative to the 20 watt power level.

The overload recovery characteristics of this amplifier had to be evaluated in a slightly different way to the normal, in that when subjected to a continuous power level at the rate of 201 watts the amplifier rapidly shuts down, so we had to pick a reference point that was some 10 dB down with respect to the maxi- ▶

mum rated power in order to be able to evaluate the amplifier's performance. Notwithstanding, the amplifier's recovery is rapid and normal. In subsequent subjective and objective testing we found that there were no hang-ups in this respect whatsoever. Likewise, when subjected to a short circuit on the output or anomalous electrical connections the overload protection circuit functioned completely reliably and effectively.

The inside of the unit is an absolute delight to behold, for it consists of a *very, very small power transformer* located on the bottom of the chassis, with electrically isolated mechanical connections, and a series of remarkably small epoxy glass printed circuit cards. These are interconnected by means of a series of unusual power transistor sockets located on an internal subchassis at the rear of the amplifier. The components that have been used are primarily of normal American and Japanese consumer electronics origin, with the exception of the output transistors, which are matched sets of selected Motorola power transistors. These are mounted on a remarkably small heatsink, which uses the main chassis as a supplementary radiating element. When one looks at the amount of electronics incorporated in this unit you gain an even greater respect for what Bob Carver has achieved.

One natty design feature, which is in keeping with something that I have often done myself, involves the use of silicone adhesive to hold the printed circuit card with the LED array for indicating peak power level and strobe faulting on the front panel of the unit. This plugs into a simple socket in the main unit.

To the ear

The most important test of an amplifier of this type still lies in the realm of the subjective test, where the amplifier's performance, when connected to other high-quality components, tends to be subjected to what can well be described as the 'acid test'. For this particular test, the amplifier was connected to a Yamaha C-4 Natural Sound preamplifier. The drive signals were provided by an AIWA AD6900 cassette recorder and Technics SL1200 record player. This record player was fitted with a Shure SME arm and Audio-Technica AT30E moving coil cartridge. The output of the amplifier was fed to a pair of B&W 801 loudspeakers capable of handling the 200 watts a side without complaint. For reference purposes a Yamaha M2 power amplifier, with power rating slightly greater than that of the Carver, was used as a yardstick.

The programme content used for the evaluation consisted of a new Telarc digital recording (10042) of Lorin Maazel conducting the Cleveland Orchestra with Moussorgsky's 'Pictures At An Exhibition' and a Digital Mastering Direct Cassette, 'Classics Live' Concert Volume 2 (DM002), from Nakamichi Corporation, Tokyo. The main reference passage was taken from the Symphonic Poem 'Sorcerer's Apprentice'.

In terms of sheer power, the M400 displayed outstanding performance. Intermittent peaks of 105 decibels were readily produced at 4 m from the speakers, with regular peaks of over 100 decibels for at least 5% of the time. Whilst normal distortion was inaudible, there were some clear subjective differences in the sound compared with the conventional power amplifier. These differences are subtle in nature, and are apparently related to the commutation mechanism.

In many other reviews I have stated that I could not detect any difference in sound between the amplifier being reviewed and the other reference amplifiers which I was using. In this particular case I feel that such differences are just audible, primarily at the highest output levels rather than at low levels where they are apparently inaudible.

Summary

The M400 amplifier has a potency out of all proportion to its size, and at a recommended retail price of $820 is approximately $2 per watt. This is comparable or slightly better than other amplifiers in the same performance range, but this amplifier is smaller, very much neater and as we found, virtually impossible to destroy.

The Carver amplifier is clever, innovative, and very powerful. It achieves the majority of the parameters claimed for it, only falling short in terms of the 'active, or dynamic, signal-to-noise ratio'. ●

CARVER M400 MAGNETIC FIELD AMPLIFIER

Dimensions:	*180 mm high x 175 mm wide x 178 mm deep*
Weight:	*4.3 kg*
Price:	*$820*
Manufactured:	*In America by the Carver Corporation.*
Distributed by:	*Convoy International, 4 Dowling St, Woolloomooloo NSW.*

MEASURED PERFORMANCE OF CARVER M400 MAGNETIC FIELD POWER AMPLIFIER S.N. 9965B

FREQUENCY RESPONSE: Tone Controls Defeated
(-3dB re 1 Watt, 0.5V Input to Aux)
Left 1Hz to 86kHz
Right 1Hz to 95kHz

SENSITIVITY:

		Left	Right
(for 1 Watt in 8)	AUX	90mV	92 mV

INPUT IMPEDANCE:

	Left	Right
AUX	15 kΩ	15 kΩ

OUTPUT IMPEDANCE: 90 milliohms (@ 1kHz)

HARMONIC DISTORTION:

(A) (At Rated power of 201 Watts into 8Ω = 40.1 Volts)

	100Hz	1kHz	6.3kHz
2nd	-80.9	-	-85.1dB
3rd	-80.6	-74.3	-83.8dB
4th	-76.8	-	-88.9dB
5th	-77.8	-	-dB
THD.	0.02	0.019	0.009%

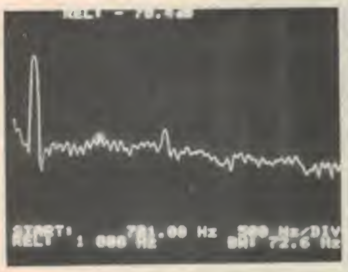
(B) (At 1 Watt into 8Ω)

	100Hz	1kHz	6.3kHz
2nd	-84	-80	-69.4dB
3rd	-88.4	-94.2	-86.6dB
4th	-95.3	-86.6	-85.2dB
5th	-	-98.6	-dB
THD	0.0076	0.011	0.03%

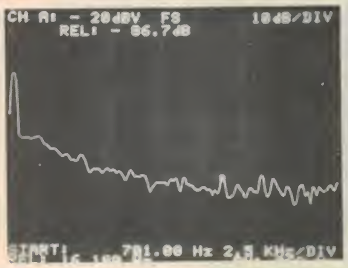
TRANSIENT INTERMODULATION DISTORTION: Not measurable
(3.15kHz square wave and 15kHz sine wave mixed 4:1)

NOISE & HUM LEVELS:
re 1 Watt into 8) AUX 82 dB (Lin) 84.5 dB(A)
(with volume control set for 1 Watt output with, 90mV input (Aux)

MAXIMUM OUTPUT POWER AT CLIPPING POINT:
(IHF-A-202)
(20mS burst repeated at 500mS intervals) (8oHms) 126 V P-P
= 248 Watts
Dynamic Headroom = 0.9 dB (re 201 Watts)



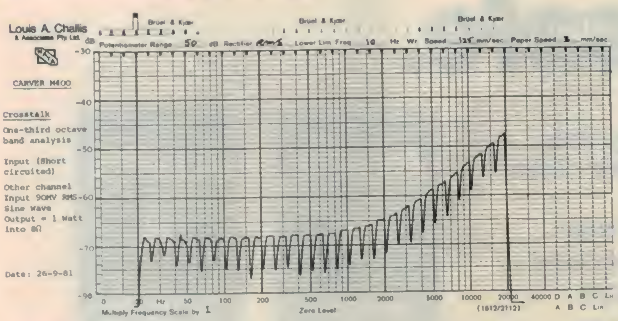
Carver amplifier at 200 watts output; 5 kHz narrow bandwidth analysis of noise and distortion for fundamental 1 kHz signal pre-attenuated by 60 dB. Note that the noise threshold is comparable with the harmonics at −78.4 dB.

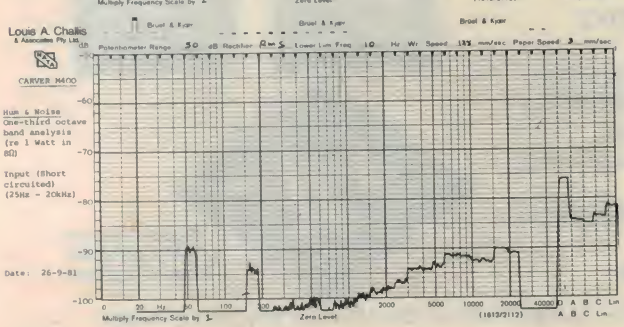


Carver amplifier at 200 watts output; 25 kHz bandwidth analysis of noise & distortion from 1 kHz signal. 1 kHz pre-attenuated by 60 dB. Note the general commutation noise below 17 kHz.

Sansui B77 amplifier at 60 watts (max.) output; 5 kHz narrow bandwidth analysis of distortion of 1 kHz signal pre-attenuated by 60 dB. Note that the third harmonic is −86.7 dB reference the real fundamental and that the noise threshold is at least −15 dB compared to that harmonic.

Measured performance of Carver M400 Magnetic Field Power Amplifier. Transient overload recovery test (IHF-A-202), 50 ms/div. 10 dB overload re rated power into 8 ohms — both channels driven. Overload duration: 20 ms; Repetition rate: 512 ms.





Sound safe.

Agfa SUPERFERRO– the sound safe– will record and store your music safe in sound, ready for when you want it. And we mean all the music. The outstanding performance of Agfa SUPERFERRO is achieved through the use of a particular form of ferric oxide particle that is uniform in shape and size. The second factor is an Agfa technique that enables more particles to be deposited per sq. mm of tape, with each particle separated and in line to eliminate cross-over interference.

The advanced technology of the SUPERFERRO tape results in five big improvements:

1. Reduced background noise.
2. Better maximum output level.
3. Improved dynamic range.
4. Improved high frequency output level.
5. Reduced harmonic distortion.

In addition, Agfa SUPERFERRO cassettes feature a special mechanism for improved running properties.

Agfa SUPERFERRO– the sound safe you can bank on for outstanding performance.

Agfa*

*Registered trademark of AGFA-GEVAERT Antwerp/Leverkusen.

AGFA-GEVAERT FOR STILL CAMERAS, FLASHGUNS, COLOUR FILM FOR SLIDES, PRINTS AND MOVIES, MAGNETIC TAPES.

MINI-MART

Where readers can advertise — For Sale/Wanted/Swap/Join.

● We'll publish up to 24 words (maximum) totally free of charge for you, your club or your association. Copy **must** be with us by the 1st of the month preceding the month of issue. Please — **please** — print or type adverts clearly, otherwise it may not turn out as you intended! Every effort will be made to publish all adverts received; however, no responsibility for so doing is accepted or implied. Private adverts only will be accepted. We reserve the right to refuse adverts considered unsuitable.

● **Conditions:** Name and address plus phone number (if required) must be included within the 24 words. Reasonable abbreviations, such as 25 W RMS or 240 Vac, count as one word. Adverts must relate to electronics, audio, communications, computing etc — general adverts cannot be accepted.
Send your advert to:
ETI Mini-Mart, Modern Magazines
15 Boundary St,
Rushcutters Bay NSW 2011

AUDIO

FOR SALE: ETI 740 FM tuner with LED tuning. $75 o.n.o. Ring Salvatore after 5.30pm (02)66-5120.

THE RECORDING SOCIETY of Australia, established 1964, invites you to join monthly demonstrations, lectures, live recordings, etc. For information and syllabus write to Don Patrick, 36 Argyle St, Macleod Vic 3085. Phone (03)459-1717.

AUDIO FREQUENCY tracer/spectrum analyser. Meguro MAT-142. Specifically designed for audio work (20 Hz-20 kHz), THD, IMD & dynamic range measurements. Perfect condition, sacrifice $2250 ono. (02)869-1840.

WANTED: DECCA International pickup arm, old model. Also origi. model JH turntable. Will phone anywhere in Aust. to discuss. Fred, Box 24, Chadstone Centre Vic. 3148.

VALVE AMPLIFIERS: Harmon Kardon A230 integrated amp, 20 W RMS/ch, $120. Pioneer SM-83 24 W RMS/ch, recently overhauled, $100. Pioneer Stereomaster, $30. Circuits, h/books. Prices negotiable. (02)869-1840.

B&O 4002 TURNTABLE plus MMC20CL cartridge. PC, $550. Pair Yamaha NS1000M speakers plus stands. PC $1000. Phone Paul (07)370-2972.

COMMUNICATIONS

C.B. RADIO to sell, plus antenna and two microphones for car or home, $125 ono. Ring (02) 772-2147, Steven.

LINEAR AMPLIFIER 3 kW PEP 1 kW continuous made by ETO Model 76P, $1500. Drake transceiver TR4CW, 300 watts, PEP XTAL filter and noise blanker, ac & dc supplies, $600. All as new (02) 76-9647 after 5 pm.

SWLs/DXers: Join Australia's National Southern Cross DX Club (Inc). Details for a 24c stamp to P.O. Box 64, Campbelltown SA 5074.

WANTED: Modules, parts, valves for Collins R391/URR. John O'Sullivan, Lot 3, Plover St, Peregian Beach, Queensland 4573.

STRATHFIELD SOUTH HIGH SCHOOL students' radio station seeks donations of discarded audio/studio equipment, esp. ribbon mic, amps, cable, T/Ts, line tranfs. (02)642-4422.

WANTED TO BUY for handicapped technician: valve broadcast, aerial, RF and Osc coils, legible connection data essential. (075) 35-1098.

MISCELLANEOUS

FLUKE 8050A microprocessor-controlled, 4½ digit, 0.03% DVM, ac/dc, self-calculating dBm through 16 impedances, TRU-RMS, resistance to 100 000 megohms. New, cannot afford to keep — $399.(02)527-2873.

TEXAS INC programmable 58 ROM plus manuals, $95; JVC M201 stereo mic + stand, $100. (02)527-2873.

SELL: TRIO CS1560 dual trace 15 megahertz CRO, 2 x PC 17 probe, as new, $550. G. Watson, 34 Bream St, Coogee NSW. (02)665-1466.

FOR SALE: 140 back copies Electronics Australia (older); and quantity of hobbyist's junk: radios; amplifiers; car radios; etc. mainly valve. $65 the lot. (02)337-5348.

JUNK FOR SALE: My junk box is threatening to take over. A great pile of components, bits and pieces going cheap. Please phone for list. David Glover (02)449-7454.

EXCHANGE teleprinters and assorted computer equipment for old 4/5 string banjo, violin, flute. Hope to become a semiconductor with a Bach worse than my byte. Ph. (08)223-2296 ah.

COMPUTERS

SELL: ZX80, 8K BASIC, 16K RAM, power supply, manual, dirt cheap, $375. SYM-1, never used, $150. Phone Mick or leave message any time, (062)41-5140, Canberra.

S.M. ELECTRONICS Z80 CPU/S100 system featuring Televideo/TV1912, VDU terminal. 11 slot fancooled 19" card cage, 15 amp supply. 4 MHz CPU, 2 serial/9 paralleled I/O ports, 48K dyanmic RAM, 16K EPROM with Cromemco 3K BASIC, dc. $2500. Phone (03)531-3207.

MICROACE/ZX80: Single-board computer, comes with 16K RAM module, 4K BASIC ROM. Peak performance modifications added. Cost $360, sell $280. Phone David Wales (02)399-6473.

FOR SALE: ZX80 complete with updated 8K ROM, with power pack and books. Very little use. $200. (08)255-4933.

S100 BOARDS built and tested, Versafloppy 1 $165, Expandoram 64K $240, Promburner $85, video terminal $350, more. S.O. Gallagher, 466 North Rocks Rd, Carlingford. (02)871-2858.

AUSTRALIAN ZX80 Users Association for ZX80 and MicroAce owners. Send 30¢ stamp for introductory newsletter to: AZUA, 19 Godfrey Street, Campbell ACT 2601.

EA VDU board with crystal and modulator, assembled and tested, $40. Moulded keyboard, unencoded, $20. 16K static RAM SS50 buss, $160. Phone R. Steedman, (051)56-8291.

SELL: DREAM 6800, Chipos and other manuals, power supply, RAM board, programs on cassette; in functional cabinet. $290. Gerald, (03)277-4870 ah.

DURA Mach 10 IBM ball typing head 240 V typewriter suitable for output printer, $500. R. Long, 46 Gloucester St, Sydney NSW 2000. (02)27-2982.

FOR SALE: 16K Exidy Sorcerer Mk I. Excellent condition, $1050 ono, all offers considered. I. Pollard, 1 Wynn Street, Fraser ACT 2615. (062) 58-6779.

BIGBOARD BY FERGUSON: Monitor Source Listing decoded and annotated — $15. Also improved character generator EPROM. Richards, 25 Bowline St, Jamoboree Heights Qld 4074. (07)376-3323.

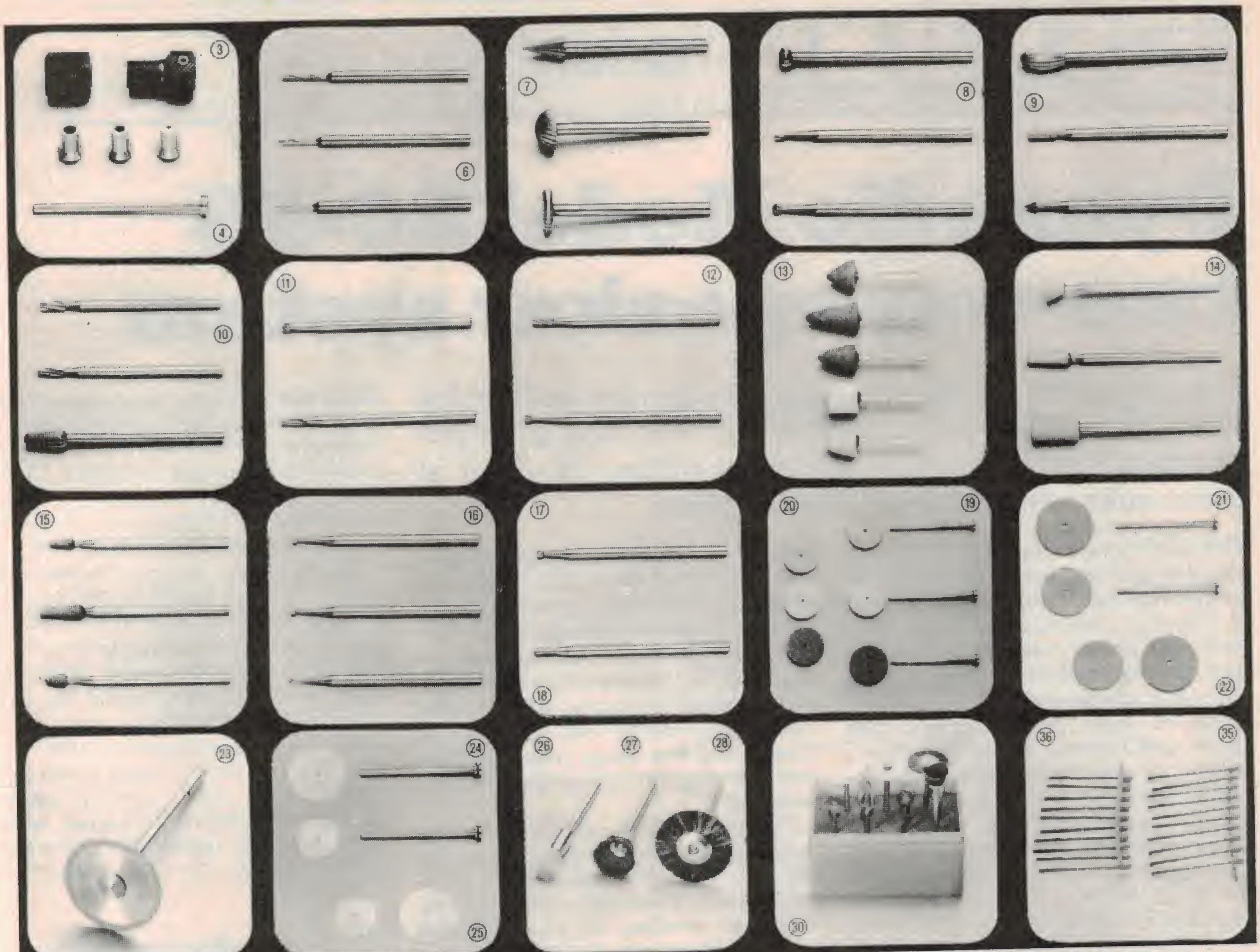
FOR SALE: Tandy model 3, complete with 48K RAM, line printer (7) and system desk, $1850. Phone Mike (02)76-8112 home or (02)82-1943 bus.

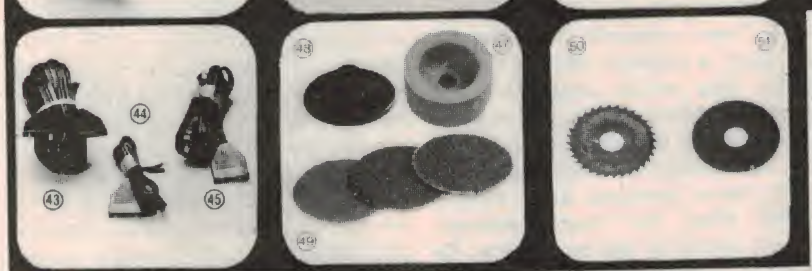
PRINTER, Base 2, Model 800, all options, 100 cps, $650. Teletype KSR33, 110 baud, $230. UV-lamp unit, 24 inch, $68. Raytheon DIDS-400 terminal, less chassis, $65. (03)862-1998.

TO SWAP: System 80/TRS80 programs, send SAE for list of programs to T.Koziniec, 58 South Coast Hwy, Albany W.A. 6330.

SALE: SPC 16/40 16-bit computer, DBOS, BASIC, Macro, FORTRAN, cabinet, Caelus 5-M toploading disk, Centronics 101 LP, ASR 33/38, documentation card reader, power supply, $1500. Steve (046)26-1232.

OSI SUPERBOARD complete with 8K RAM, RS232 interface and power supply, all in one case. Cassette software and listing available, $450 ono. Phone Alec (02)46-1976, Sydney.





3 **Three-piece chuck set** with brass insert for 1/2, 4/ and 3 mm Ø
order No. 000.62.886

4 **Support piece** suitable for the above interchangeable equipment Shaft made of stainless steel Ø 2.35 mm
order No. 000.63 507

6 **"Mikro" three-piece set of twist drill bits** made of high-grade special steel, shaft Ø 2.35 mm, bit Ø 0.5/0.7/0.8 mm
order No. 000.63.007

7 **Three-piece milling set** shaft Ø 3 mm
- conical with sharp tip, coarse-toothed head Ø 5.8 mm, head length 10.8 mm
- semi-circular, coarse-toothed head Ø 9.9 mm, head length 4.9 mm
- pinion-type, coarse-toothed head Ø 9.9 mm, head length 2.3 mm

order No. 000.62.457

8 **Three-piece milling set** made of high-grade special steel, shaft Ø 2.35 mm
- circular, coarse-toothed, head Ø 2.3 mm
- conical, coarse-toothed, head Ø 2.3 mm, head length 2 mm
- oval, coarse-toothed, head Ø 4 mm, head length 2.1 mm

order No. 000.63.105

9 **Three-piece milling set** made of high-grade special steel, shaft Ø 2.35 mm
- oval, coarse-toothed head Ø 0.5 mm, head length 9.8 mm
- pointed, coarse-toothed head Ø 2.3 mm, head length 3.1 mm
- cylindrical, coarse-toothed with cross stroke head Ø 2.3 mm, head length 6.2 mm

order No. 000.63.114

10 **Three-piece milling set** made of high-grade special steel, shaft Ø 2.35 mm
- cylindrical, coarse-toothed head Ø 2.3 mm, head length, 6.1 mm
- conical, coarse-toothed head Ø 2.3 mm, head length 6.4 mm
- bud shaped, coarse-toothed head Ø 5 mm, head length 10 mm

order No. 000.63.123

11 **Two-piece carbide drilling set** made of high-performance carbide, shaft Ø 2.35 mm
- circular, coarse-toothed head Ø 2.3 mm
- conical, coarse-toothed head Ø 1.8 mm, head length 5 mm

order No. 000 63 132
Illustration at next page.

12 **Two piece carbide drilling set** made of high-performance carbide, shaft Ø 2.35 mm
- cylindrical, coarse-toothed head Ø 1 8 mm, head length 5 mm
- conical, coarse-toothed head Ø 1.8 mm, head length 1.6 mm

order No. 000 63 141

13 **Five-piece set of grinding bits** head made of corundum, shaft Ø 3 mm
- conical with attachments head Ø 14.9 mm, head length 15.8 mm
- conical, head Ø 13.6 mm, head length 18.1 mm
- bud shaped, pointed head Ø 13.6 mm, head length 20.4 mm
- cylindrical head Ø 13 4 mm, head length 13.3 mm
- bud shaped, blunt head Ø 13.2 mm, head length 15 mm

order No. 000.62 448

14 **Three-piece set of grinding bits** head made of corundum, shalt made of steel, nickel-plated, stainless, shaft Ø 2.35 mm
- trapezoidal, head Ø 7 5 mm, head length 5.2 mm
- conical head Ø 4 mm, head length 10.7 mm
- head Ø 6 4 mm, head length 12.1 mm

order No. 000.63.203

15 **Three-piece glass grinding set** for surface grinding of glass. Head made of silicon carbide, shaft made of steel, nickel-plated, stainless, Ø 2.35 mm
- conical, short head Ø 2.6 mm, head length 6.1 mm
- conical, long head Ø 3.7 mm, head length 10 8 mm
- bud shaped, pointed head Ø 3 1 mm, head length 5 8 mm

order No. 000.63 212

16 **Three-piece glass cutting set** for cutting contours on glass Head with natural diamand, shaft made of stainless steel
Ø 2.35 mm, head Ø 1/1, 1/4/1.6 mm
order No. 000.63.221

17 **Diamond grinding bit, circular** with high-grade steel shaft, stainless Ø 2.35 mm. Equipped with high-grade natural diamond using a special method, head Ø 1 8 mm
order No. 000 63.230

18 **Diamond grinding bit, cylindrical** with stainless steel shaft, Ø 2.35 mm Equipped with high-grade natural diamond using a special method, head Ø 1 8 mm, head length 4 mm
order No. 000.63 249

19 **Three-piece set of grinding wheels** complete with three support pins Ø 2.35 mm, grinding wheel Ø 19 mm thickness 1.5 mm
- green, made of silicon carbide
- pink and white, made of corundum

order No 000 63 258

20 **Three-piece set of spare grinding wheels**, without support pin, grinding wheel Ø 19 mm, thickness 1.5 mm
- green, made of silicon carbide
- pink and white, made of corundum

order No. 000.63 267

21 **Two-piece set of friction discs** complete with two support pins Ø 2.35 mm, friction discs made of corundum
- Ø 22 mm, 0 6 mm in thickness
- Ø 25 mm, 1.0 mm in thickness

order No. 000.63 276

22 **Two-piece set of spare friction discs** without support pins, friction discs made of corundum
- Ø 22 mm, 0.6 mm in thickness
- Ø 25 mm, 1.0 mm in thickness

order No 000 63 285

23 **Diamond friction disc** with support pin made of stainless steel Ø 2 35 mm Equipped with high-grade natural diamond using a special process Ø 18 mm, 0.7 mm in thickness
order No 000 63 294

24 **Two-piece set of circular saw blades** complete with two support pins made of special stainless steel Ø 2 35 mm, saw blade Ø 16/22 mm
order No 000 63 301

25 **Two-piece set of spare circular saw blades**, without support pins, made of special stainless steel, saw blade Ø 16/22 mm
order No. 000 63.310

26 **Three-piece set of steel wire brushes** with shaft Ø 2 35 mm
- disc-type brush Ø 22 mm
- cup-type brush Ø 15 mm
- standard-type brush Ø 4 mm

order No. 000 63 409

27 **Three-piece set of brass wire brushes** with shaft 2 35 mm Ø
- disc-type brush Ø 22 mm
- cup-type brush Ø 15 mm
- standard-type brush Ø 4 mm

order No. 000.63 418

28 **Three-piece set of Chungking brushes** Chungking brushes, shaft Ø 2.35 mm
- disc-type brush Ø 22 mm
- cup-type brush Ø 12.5 mm
- standard-type brush Ø 3.35 mm

order No. 000.63.427

30 **Ten-piece model building tool set** all with shaft Ø 2.35 mm
- Three corundum grinding bits
- Three milling bits
- Two brushes, plastic
- One felt disc on support pin
- One circular saw on support pin

order No 000.62.439

35 **Saw blades for jigsaw**, set of ten, coarse
order No 000 62 117

36 **Saw blades for jigsaw**, set of ten, line
order No 000 62 144

43 **3 m extension lead**
order No 000 62 091
– without illustration –

44 **Transformer adapter**
order No 000 62 064
– without illustration –

45 **Car adapter 12 volt**
order No 000 62 073
– without illustration –

47 **Cup grinding wheel** made of corundum Ø 32 mm, complete with mount
order No 000 63 623

48 **Grinding disc**, set of three, Ø 40 mm
order No 000 63 632

49 **Sandpaper**, self-adhesive, circular, set of ten Assorted line, medium and coarse, Ø 40 mm
order No 000 63 641

50 **Saw blade for wood** Ø 32 mm, complete with mount
order No. 000,63 669

51 **Saw blade for metal** Ø 32 mm, complete with mount
order No 000 63 678

Dynaudio Model 20-55 two-way speaker system

The Dynaudio 20-55 speakers incorporate quite a few innovations which increase their efficiency and give them excellent stereo imaging and power handling. However, all is not quite rosy, as Louis Challis reports.

THE DESIGN of loudspeaker systems is complex and time-consuming. The pre-eminent manufacturers of loudspeakers in England, America and Japan have slowly but surely resorted to some of the most esoteric methods to determine the whys and wherefores of their products. Some of these manufacturers, like K.E.F. and Technics, have devoted their efforts to developing computer programs which evaluate the transient acoustic performance of their loudspeakers, whilst others like B&W have investigated the physical movement of the loudspeaker, as they believe this provides a more direct clue as to how to solve the problems before they become problems.

Problems, problems

Over the last fifteen years I have become more and more aware of some of the factors which give rise to acoustic problems in loudspeakers, and these are many and varied. They include, amongst others, speaker resonance problems, break-up of speaker diaphragms, non-uniform vibrational flexure of voice coils, interaction of edge surrounds and flexible surrounds with the radiated sound field, interaction between the acoustic output of two-way, three-way, four-way and sometimes (God forbid) five-way speaker systems (I hope we've seen the last of those!). Very common problems in cheap speakers are created by the resonance characteristics of the speaker enclosure, of the speaker baskets themselves and last but not least anomalous phase responses from poorly located mid-range speakers and tweeters.

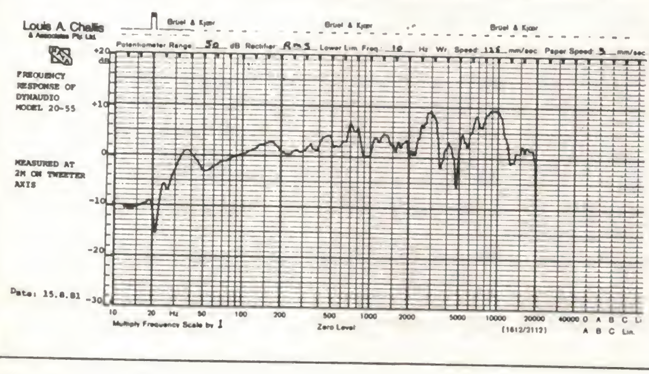
The sorts of solutions offered to solve these problems have ranged from esoteric electrostatic tweeters to concrete field speaker enclosures, from multiple arrays of tweeters to passive-loaded radiators to improve the low frequency response, from research programmes costing half a million dollars to an ingenious idea which emerges as a commercial product one week only to disappear off the market the next. Obviously, the design of loudspeakers is becoming more complex, more expensive and from the manufacturers' standpoint probably less rewarding. To the average man in the street the task of selecting a loudspeaker must be absolutely frightening, for each manufacturer presents claims which are often unsupported and extremely complex to prove or disprove. Even the simple ear test is no real test in many cases where the listener has been preconditioned to the sound of a transistor radio playing an AM radio station through a 75 mm (3 inch) loudspeaker. After that sort of 'hors d'oeuvre' anything tastes good — even a speaker loaded with problems.

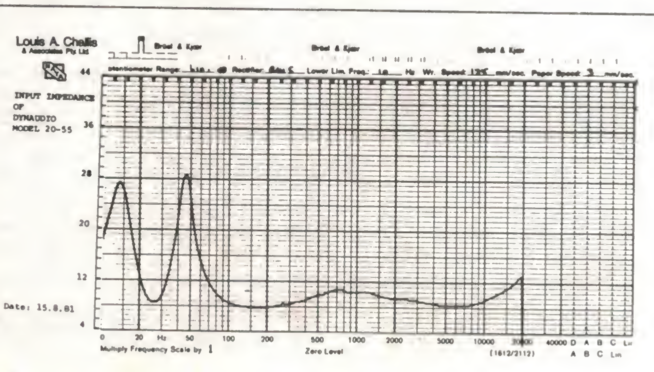
We too have become increasingly aware of the problems of speaker evaluation and have devoted considerable time and ingenuity to improving both our objective and subjective assessments of loudspeakers. The Dynaudio 20-55 loudspeaker system is one which we first evaluated in 1980, at a time when we were initially proving the merits of our decay response spectra speaker evaluation techniques whilst simultaneously updating our monitoring facilities for comparison of loudspeakers.

The Dynaudio approach

The Dynaudio Model 20-55 two-way speaker system exemplifies the lengths to which a manufacturer will go to overcome a number of the problems facing a conventional loudspeaker system. The enclosure is remarkably solid and is as free of cabinet resonances as any that we have ever seen. These characteristics are achieved through extensive internal bracing and the application of composite materials which provide high damping concurrent with high mass.

The main driver, a Model 21W-54 speaker with a 220 mm diameter cone, incorporates a patented hexacoil wire





voice coil for which the manufacturers claim a 30% increase in efficiency and in the force factor over that provided by a comparable conventional circular wire voice coil. Obviously, with such improvements in efficiency one would expect high output and reasonable sensitivity, and subsequent testing showed this to be the case.

The tweeter is a model D28 soft-domed speaker with a 28 mm diameter diaphragm which incorporates a magnetic fluid between the voice coil and the magnet assembly to enhance voice coil damping and simultaneously improve transient response. This approach may or may not achieve enhancement of transient performance, depending on the design of the tweeter itself, but the addition of the magnetic fluid unquestionably improves the thermal dissipation capabilities and thus the ability to handle high-level signals without destroying the speaker. All the drivers are of Danish manufacture.

The enclosure incorporates oak-veneered particle board side panels with a well-designed open weave brown grille cloth retained by means of Velcro-type fasteners. The woofer incorporates a wide EPDM rubber surround to provide the long throw travel the diaphragm needs to achieve, whilst the tweeter is recessed well back behind the front panel to meet the phase requirements of a linear phase system. The rear of the cabinet features a Bulgin-type speaker socket, for which a mating plug and two metre long lead are also provided.

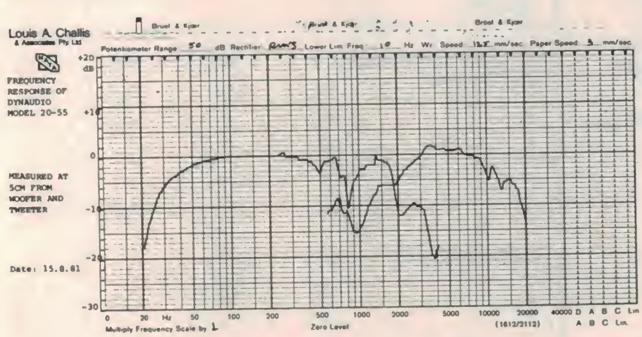
On test

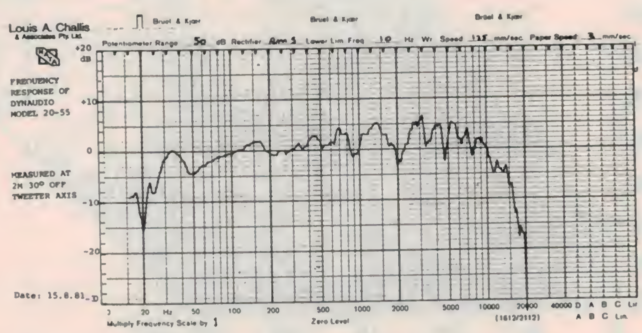
The frequency response of this speaker system extends from 35 Hz to beyond 20 kHz, with some unusual peaks and ripples occurring in the frequency domain of the tweeter. The low frequency response is dominated primarily by the interaction between the loading port vent and the woofer, which are placed closer together than in most other speaker systems of this type. The speaker resonance occurs at 45 Hz, with an unusual subresonance occurring at 14 Hz. It is apparent from a comparison of the near field frequency response with the response at 2 m that a different location for the loading port would most probably improve the low frequency linearity.

The impedance curve is remarkably close to an optimum 8 ohm impedance and as such the speaker could readily be paralleled with other 8 ohm speakers without creating problems.

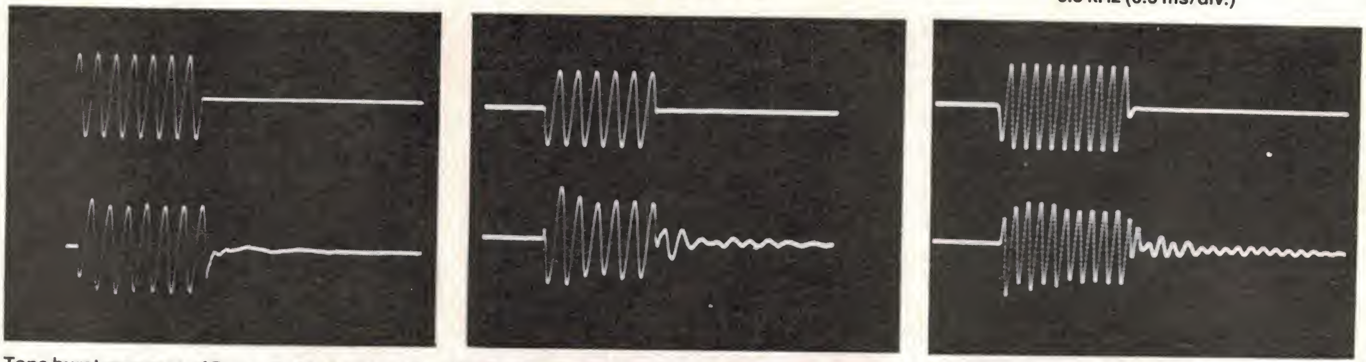
The tweeter response is not nearly as smooth as we would like and this comes primarily as a result of the design of the tweeter, which our measurements indicate falls short of the sort of performance that the best tweeters are capable of providing. In particular, the drooping characteristic above 10 kHz is regrettable and this is compounded by what appear to be reflections from the recessed face of the enclosure. These do not show up in the near field response but do in the far field response.

The phase response of the speaker is generally smooth and quite good, but even here minor reflections from the recessed face show up in terms of a small ripple. The distortion characteristics of the speaker are particularly good, and even the distortion level at 100 Hz when producing 90 dB at two metres is very low at only 0.9%.





100 Hz (20 ms/div.) | 1 kHz (2 ms/div.) | 6.3 kHz (0.5 ms/div.)



Tone burst response of Dynaudio Model 20-55 (for 90 dB steady-state SPL at 2 m on axis). Upper trace is electrical input; lower trace is loudspeaker output.

By and large the speaker has obviously been designed to deliver high outputs with generally low distortion, and subsequent testing confirmed this. The decay response spectrum of the speaker exhibits similar non-uniformity to that determined by us a year ago, and this non-uniformity is directly attributable to the tweeter; we believe this could be improved by a change of physical characteristics of the soft dome, which must be generating its own resonant characteristics, particularly in the vicinity of 2 kHz and also in the 10 kHz region.

To the ear

The subjective testing of the speaker was more rewarding on this occasion than it was a year ago, and the Dynaudio speakers proved to have exceptional power handling capabilities, with the ability to produce sound pressure levels in excess of 105 decibels at 4 m distance in our monitoring room. Under these conditions, peak power levels approaching 300 watts were accepted without significant complaint, but positive colouration of the sound was evident, particularly on trumpets and other wind instruments, which demonstrated strident characteristics atypical of the programme content.

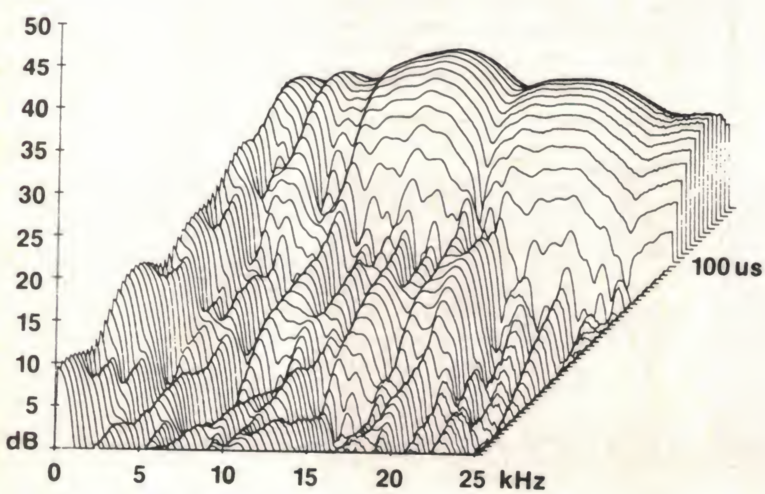
The speakers were driven by a Yamaha B4 amplifier with the ability to provide 350 watt peak signals, and the speakers did not miss a beat. When playing violins, organs, pianos and guitars the colouration was not particularly pronounced and the sound was, with this type of programme content, very similar to the monitors. When playing Tedare's Moussorgsky's 'Pictures At An Exhibition' (10042) and a Nakamichi Digital Mastering Direct Cassette 'Jazz Fusion Studio Live' (DM001) the speakers provided a generally good performance, only marred by colouration in the 2 kHz region, primarily on woodwinds, trumpets and trombones.

Summary

The Dynaudio speakers provide excellent stereo imaging, power handling capacity and particularly low distortion. Given that their selling price is close to $1500, it would be a shame if the manufacturers did not spend a little extra time in minimising the decay resonance characteristics of the tweeter to achieve a performance which is already so close to their design aims. ●

DYNAUDIO 20-55 LOUDSPEAKERS

Dimensions:	*675 mm high x 396 mm wide x 400 mm deep*
Weight:	*31 kg*
Price:	*About $1500*
Manufactured by:	*Dynaudio Australia Pty Ltd.*
Distributor:	*Dynaudio Australia Pty Ltd, P.O. Box 2, Hawthorn Vic. 3122.*



MEASURED PERFORMANCE OF DYNAUDIO MODEL 20-55

FREQUENCY RESPONSE:		30Hz-20kHz		
CROSSOVER FREQUENCIES:		1800Hz		
SENSITIVITY: (for 90dB average at 2m)		10.5 VRMS = 13.8 Watts (nominal into 8Ω)		
HARMONIC DISTORTION: (for 90dB) at 2m)		100Hz	1kHz	6.3kHz
	2nd	-44.3	-49.1	-40.8
	3rd	-43.6	-54.9	-53.5
	4th	-	-	-
	5th	-58.1	-	-
	T.H.D.	0.9%	0.4%	0.94%
INPUT IMPEDANCE:	100Hz	8.6 Ω		
	1kHz	10.4Ω		
	6.3kHz	8.4 Ω		
Minimum at	170Hz	7.8 Ω		

Electronics Today International is published by Murray Publishers Pty Ltd, 15 Boundary St, Rushcutters Bay NSW 2011. It is printed (in 1981) by Offset Alpine, cnr. Wetherill and Derby Sts, Silverwater NSW, and distributed by Gordon and Gotch.

Editor
Roger Harrison VK2ZTB

Technical Editor
David Tilbrook VK2YMI

Production Editor
Jane Clarke B.A. (Hons)

Editorial Staff
William Fisher B.Sc. (Hons)
J.B. Scott B.Sc./B.E. (Hons) VK2YBN
Jan Vernon B.A.
Phil Wait VK2DKN

Layout
Bill Crump

Typesetting
Lin Booth

Reader Services
Jan Collins

Managing Editor
Collyn Rivers

Acoustical Consultants
Louis Challis & Associates

Mail enquiries: There is no charge for replies, but a foolscap-sized, stamped, addressed envelope must be enclosed. Queries relating to projects can only be answered if related to the item as published. We cannot advise on modifications to projects, other than errata or addenda, nor if a project has been modified or if components are other than specified. We try to answer letters as soon as possible. Difficult questions may take time to answer.

Phone enquiries: We can only answer readers' technical enquiries by telephone after 4.30 pm. In enquiring by telephone about back issues or photostats, please ask for the Subscriptions Department.

(02)33-4282

Editorial and Sales Office:
4th Floor, 15 Boundary St, Rushcutters Bay NSW 2011. Ph. 33-4282; Tlx: 27243
Sales Manager: **Bob Taylor**
Sales Admin: **Jan Collins**
(address as above)

Melbourne: Virginia Salmon, 150 Lonsdale St, Melbourne Vic 3000. Ph: 662-1222; Tlx AA34543.

Adelaide: Admedia Group, 24 Kensington Rd, Rose Park SA 5067. Ph: 332-8144; Tlx AA82182.

Brisbane: Geoff Horne Agencies, 16 Bellbowrie Centre, Bellbowrie Qld 4070. Ph: 202-6813.

Perth: Aubrey Barker, 133 St Georges Terrace, Perth WA 6000. Ph: 322-3184; Tlx: AA93810

New Zealand: Frank Hargreaves, Circulation Marketing Manager, c/- ACP, 4th Floor, Sun Alliance House, 42-44 Shortland St, Auckland. Ph: (9)30311.

United Kingdom: Australian Consolidated Press, Ludgate House, 107 Fleet St, London EC4A 2AL. Ph: 353-1040; Tlx: 267163.

Japan: Genzo Uchida, Bancho Media Services, 15 Sanyeicho, Shin juku-Ku, Tokyo 160. Ph: 359-8866; Cable: Elbanchorito; Tlx: BMSINC J25472 Tokyo.

USA: Australian Consolidated Press, 21 East 40th Street (Floor 23), New York NY 10016. Phone. (212) 685-9570.

ORDER FORM

I enclose $ . . . . for (tick appropriate box/es). All prices include postage.
Send orders to: ETI, 4th Floor, 15 Boundary St, Rushcutters Bay NSW 2011. Phone: (02)33-4282.

☐ **Subscriptions** — $23.30 per year within Australia $ . . . .
$36.60 overseas (surface mail) $ . . . .
Airmail rates on application

☐ **Back issues** — $2.50, available from November 1978.

☐ **or photocopies** — $2.50 per article per issue
Project No. . . . . Month . . . . Year . . . . $ . . . .
Project No. . . . . Month . . . . Year . . . . $ . . . .
Project No. . . . . Month . . . . Year . . . . $ . . . .
Project No. . . . . Month . . . . Year . . . . $ . . . .
Please attach a list if more than four required.

☐ **Binders** — No. . . . . . . @ $6.10 in NSW $ . . . .
No. . . . . . . @ $7.50 in other states $ . . . .

NAME (Please print)
. . . .

ADDRESS . . . .
. . . .
. . . .
. . . .
. . . .
. . . . **POSTCODE** . . . . . .

DREGS

OUR 'QUOTES' competition in the July issue attracted some thoughtful entries. Most seemed to have been assisted by the Oxford Dictionary of Quotations, but that is not necessarily the primary source, so there were some interesting differences between entries as well as our quotes. Here are the correct versions and their origins (and no correspondence will be entered into ...):

1. Elementary, my dear Watson.
This is a strange misquotation. The closest to it is "Excellent!" (Dr. Watson) cried. "Elementary," said he (Holmes). Sir Arthur Conan Doyle, from 'The Crooked Man' in 'The Memoirs of Sherlock Holmes'.

2. We are the masters now.
The quote we had in mind was "We (Labour) are the masters at the moment — and not only for the moment but for a very long time to come". Sir Hartley Shawcross in the House of Commons, April 1946.

3. Come up and see me sometime.
The correct version is "Why don't you come up sometime and see me," said by Mae West in the movie 'She Done Him Wrong' — an adaptation of 'Diamond Lil'.

4. Money is the root of all evil.
Correct version is: "The love of money is the root of all evil", 1 Timothy v. 10.

5. I knew him well, Horatio.
This should be "Alas! poor Yorick. I knew him, Horatio". Spoken by Hamlet in Hamlet, Prince of Denmark, Act V Scene 1, by William Shakespear. (We know most people give the famous Bard an 'e' on his name, but our Managing Editor maintains that it was never spelt that way in Shakespear(e)'s time, and who are we to argue?)

6. Survival of the fittest.
"This survival of the fittest", from Herbert Spencer's 'Principles of Biology' (1865). Spencer was referring to the "fittest" in the sense of the **most suitable** — not the most fit physically.

7. I want to be alone.
We can do no better than to reprint the winning entrant's answer: ' "I want to be alone" is from the movie 'Grand Hotel' (1932) from a script by W.A. Drake; the words are said by Greta Garbo. However, the phrase had frequently been attributed to Greta Garbo before being used in the film; she appears in fact to have said on various occasions (off-screen) "I want to be left alone" and "why don't they leave me alone." '

8. The stuff that dreams are made of.
Should be:
"We are such stuff
As dreams are made **on**".
From 'The Tempest', Act IV, by W. Shakespear.

9. To gild the lily.
Correct version is "To gild refined gold, to paint the lily ..." Spoken by Salisbury in 'King John', Act IV, Sc.II, by W. Shakespear.

10. I must go down to the seas again.
Most entrants said that the quote was correct as printed. Not so. It's from Masefield's 'Sea Fever' and should read "I must down to the seas again" (there's no "go").

11. First catch your hare.
Not Mrs. Beeton but Hannah Glasse in the 'Art of Cookery' (1747). It reads "Take your hare when it is cased".

12. Lead on, Macduff.
Correct version is "Lay on, Macduff. And damn'd be him that first cries, 'Hold, enough!' ", from Macbeth, Act V, Sc. vii. W. Shakespear.

13. Pride goeth before a fall.
From Proverbs xvi, 18. "Pride goeth before destruction and an haughty spirit before a fall".

14. All that glitters is not gold.
There are several versions that could be taken as originally correct. However, we feel the closest is "All that glisters is not gold" from 'The Merchant of Venice', Act II, Sc. vii. I'm indebted to several readers who quoted from Thomas Gray's poem 'Ode on the Death of a Favourite Cat': "Nor all that glisters, gold".

15. Thou shalt not kill — but needst not strive officiously to stay alive.
This is another curious one. The correct version is "Thou shalt not kill — but needst not strive officiously to **keep** alive", and it's from Arthur Hugh Clough's 'The Latest Decalogue', which is an ironical version of the Ten Commandments. It was not in any way at all intended as advice to doctors — but is often taken as such now.

Two entries from the Cerini household of Kilmore East in Victoria had the least errors; they had answers to misquotes 8 and 11 incorrect, so we've arranged a special prize for Messrs J. and M. Cerini. Congratulations!

Curiously, second place was a tie between K. Mitchell of Seven Hills in NSW and Laurence Blake (just 15 years old!) of Lower Plenty in Victoria. Congratulations one and all! Thank you to all those who entered, don't miss our next exciting Dregs competition ...

PERFECT REPRODUCTION. REPRODUCED PERFECTLY.

To reproduce the true sound of a live performance has been the goal of manufacturers since Edison invented the phonograph.

At JVC, we have gone further than any other maker to achieve this goal.

First we developed the stereo groove, making possible stereophonic recording techniques.

And, more recently, we invented the amplification process known as Super A.

Quite simply, Super A gives you very high output while using very low power.

What you hear is an extremely clean, natural sound, with almost no distortion.

Another recent development is our Quartz Lock turntable.

This turntable offers an accuracy of speed impossible in conventional turntables, because it is regulated by the most accurate measure known to man. The pulse of the atom.

Then, to match the quality of these components, we produced the SEA graphic equaliser system for perfect tone control.

This system has been refined to such a degree it even compensates for the furniture in your room when the sound leaves the speakers.

The end result is the opportunity to appreciate live performance realism, without having to go to a live performance.

If you'd like to know more about the many innovations JVC has brought to Hi-Fi, write to us for a brochure or call into any JVC dealer.

Then you'll see why JVC equipment is recognised as The State of the Art.

JVC

JVC0063ETI/FMMH

For further information, write to JVC Advisory Service, Private Bag, Kingsgrove, N.S.W. 2208 or phone (02)750-3777

TELETEXT

The Information Computer you access on your own Television

- **STOCK BROKERS—SHARE MARKET ENTHUSIASTS**—Get the latest Stock Exchange and Futures market reports.
- **PUNTERS**—Get the latest odds on a race and the earliest actual results and dividends.
- Who won the cricket, football, league, tennis—get all the important results.
- What were the lotto, lottery, pool numbers—how much did it pay? **DID YOU WIN?** The results are on Teletext.
- **MUM**—How much should you be paying for fruit and veggies, meat and poultry.
- **DAD**—Read the news at your leisure.
- **KIDS**—Enjoy mastermind, jokes, graphics and puzzles.
- What will the weather be like tomorrow in Brisbane, Sydney, Perth, New York, Athens, London—**IT'S ALL ON TELETEXT.**

GET ALL THIS INFORMATION and much more from the **FREE** electronic newspaper of the 80's—**YOUR OWN** television set with an **ADAM 180 TELETEXT ADAPTOR** by **RADOFIN ELECTRONICS (AUST).**

THE ADAM 180 TELETEXT ADAPTOR

by

RADOFIN ELECTRONICS (AUST)

5 Curlewis Street, Bondi, NSW 2026, AUSTRALIA Telephones: (02) 309 1957 or (02) 309 1904